R
16.53
P578

Illinois U. Library

SCIENCE ABSTRACTS: SECTION A 1778–2599

OLUME 59

PHYSICS ABSTRACTS

UMBER 699

ARCH 1956

Published by The Institution of Electrical Engineers

SECTION A OF SCIENCE ABSTRACTS (*Section B: Electrical Engineering*)
Edited and issued by THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, London W.C.2
In association with THE PHYSICAL SOCIETY, THE INSTITUTE OF PHYSICS, THE AMERICAN PHYSICAL SOCIETY, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Co-operating member of the I.C.S.U. Abstracting Board (International Council of Scientific Unions)

Physics Abstracts

CONTENTS

MATHEMATICS	51
ASTRONOMY. ASTROPHYSICS. GEODESY	52
PHYSICS	53
Fundamentals	530.1
General mechanics. Mechanics of solids	531
Mechanical measurements	531.7
Mechanics of fluids	532
Capillarity	532.6
Molecular theory of liquids	532.7
Mechanics of gases	533
Molecular theory of gases	533.7
Vibrations. Acoustics	534
Optics. Radiation. Spectra	535
Heat	536
Thermodynamics	536.7/.8
Electricity	537
Electrostatics. Dielectrics	537.2
Electric conduction. Currents	537.3
Electric discharges	537.52
X-rays	537.531
Cathode rays. Positive rays	537.533/.534
Discharge tubes. Counters	537.54
Ionization. Thermionics	537.56/.58
Cosmic rays	537.591
Magnetism	538
Electromagnetism. Electrodynamics	538.3/.5
Electromagnetic waves and oscillators	538.56
Molecular and atomic structure	539.1
Theory of solid state	539.11
Molecules	539.13
Atoms. Nucleus. Isotopes	539.15
Radioactivity. α-, β- and γ-rays	539.16
Nuclear reactions	539.17
Atom and molecular beams. Mesons. Neutrons	539.18
Structure of solids	539.2
Elasticity. Strength. Rheology	539.3/.8
PHYSICAL CHEMISTRY	541
Phase equilibrium. Chemical reactions	541.11/.12
Electrochemistry	541.13
Photochemistry. Radiation chemistry	541.14/.15
Dispersions. Colloids. Adsorption	541.18
Chemical structure	541.2/.6
Chemical analysis	543/545
CRYSTALLOGRAPHY	548
Atomic and X-ray crystallography	548.7
GEOPHYSICS	55
Atmosphere. Meteorology	551.5
BIOLOGY	57/59
Medical science. Human physiology	61
TECHNIQUE. MATERIALS	62/69
Photography	77

The number given for each subject is the Universal Decimal Classification number; the appropriate page can be found by referring to the U.D.C. numbers printed above each abstract on the right.

The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments	Waveguides	Amplifiers
	Photocells	Electroacoustic apparatus
Electronic relays and counters	Thermionic tubes	Radiocommunication
Automatic control mechanisms	Cathode-ray tubes	Mechanical engineering
Applied electrochemistry	X-ray tubes	Illumination
Lines and networks	Oscillators. Pulse circuits	

Committee of Management
1955–56

THE INSTITUTION OF ELECTRICAL ENGINEERS
THE PRESIDENT (*ex officio*)
S. WHITEHEAD, M.A., D.Sc., M.I.E.E. (*Chairman*)
L. G. BRAZIER, Ph.D., B.Sc., M.I.E.E.
L. HARTSHORN, D.Sc., M.I.E.E.
R. L. SMITH-ROSE, C.B.E., D.Sc., M.I.E.E.

THE PHYSICAL SOCIETY
R. C. EVANS, M.A., Ph.D., B.Sc.
A. G. GAYDON, D.Sc., F.R.S.
D. ROAF, M.A., D.Phil.
MISS A. C. STICKLAND, M.Sc., Ph.D.

THE INSTITUTE OF PHYSICS
E. R. DAVIES, O.B.E., F.Inst.P.

THE ROYAL SOCIETY
T. E. ALLIBONE, D.Sc., Ph.D., M.I.E.E., F.R.S.

THE CENTRAL ELECTRICITY AUTHORITY
L. W. JAMES, M.A., A.M.I.E.E.

Editorial

EDITOR
B. M. CROWTHER, M.A., Ph.D., F.Inst.P.

ASSISTANT EDITORS
G. N. J. BECK, B.Sc., A.M.I.E.E., A.Inst.P.
N. R. FOWLER, A.R.C.S., D.I.C., F.Inst.P.
R. R. O. SKELTON, B.A.

Annual Subscriptions

Section A, £4 10 0; Section B, £3 10 0; both sections, £7 10 0.

Printed on one side only, for mounting on cards (indexes on request only):

Section A, £5 10 0; Section B, £4 10 0; both sections, £9 10 0.

Copyright. All rights reserved.

PHYSICS ABSTRACTS

Volume 59 MARCH 1956 Number 699

MATHEMATICS 51

518.5 : 681.142

1778. THE METHOD OF LANCZOS FOR CALCULATING THE CHARACTERISTIC ROOTS AND VECTORS OF A REAL SYMMETRIC MATRIX. R.A.Brooker and F.H.Sumner.
Proc. Instn Elect. Engrs, Paper No. 2017 M, publ. Feb., 1956, pp. To be republished in Vol. 103 B (1956).

Draws attention to a method suggested by Lanczos for arriving at the reduced characteristic function of a matrix, and shows how it may be used with an electronic computer to evaluate automatically the characteristic roots and vectors of a real symmetric matrix, no matter how degenerate. A.

519.2

1779. APPLICATIONS OF THE THEORY OF DISTRIBUTIONS TO SOME PROBLEMS IN MATHEMATICAL PHYSICS. I. S.Colombo.
Cahiers de Phys., No. 60, 23-40 (Aug., 1955). In French.

This is the first of four papers, in which are examined the mathematical methods of dealing with transient phenomena. The Dirac delta-function, $\delta(x)$, is defined and related to the operational calculus (Laplace) and the calculus of compositions due to Volterra and Pérès. This latter calculus is examined at some length, and it is used to explain the impossibility of effecting the inversion of certain Laplace transformations.
L.S.Goddard

519.2

1780. APPLICATIONS OF THE THEORY OF DISTRIBUTIONS TO SOME PROBLEMS IN MATHEMATICAL PHYSICS. II. S. Colombo.
Cahiers de Phys., No. 61, 25-34 (Sept., 1955). In French.

Singular integrals are defined and some of their properties are reviewed. They are used to discuss the Laplace transformation and the Dirac function $\delta(x)$. L.S.Goddard

519.271

1781. ON THE ERROR OF THE FINITE DIFFERENCE METHOD IN 1-DIMENSIONAL BOUNDARY VALUE PROBLEMS. H.Fujita.
J. Phys. Soc. Japan, Vol. 11, No. 2, 160-9 (Feb., 1956).

Bounds of the error, which is committed in approximating the boundary-value problem $-y'' + qy = f$, $y(0) = y(1) = 0$, $(q \geq 0)$, by the corresponding difference equation, are given in forms not involving the solution y and, hence, calculable without solving the original problem. The methods are based on a theorem concerning an operator of the type T*T in a Hilbert space. The degree of convergence of the difference equation solution to the differential equation solution, as the difference interval approaches zero, is also studied. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.61

1782. AN ARRANGEMENT FOR OBSERVING WEAK MONOCHROMATIC CORONAL EMISSIONS FROM THE SOLAR CORONA WITH THE POLARIZING FILTER. A.Dollfus.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1717-19 (Dec. 14, 1955). In French.

Experimental details are given of optical instrumentation designed to record photographically the contours and motion of weak, inner-coronal jets at 5303 A and 6374 A around the perimeter of the solar disk. D.R.Barber

523.11 : 550.3

1783. VULCANISM AND INTRUSIONS AS A CONSEQUENCE OF THE TIME-DEPENDENCE OF (THE GRAVITATIONAL CONSTANT) κ IN JORDAN'S COSMOLOGY. H.J.Binge.
Z. Naturforsch., Vol. 10a, No. 11, 900 (1955). In German.

523.161

1784. THE ANTARES SYSTEM. J.A.O'Keefe.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 223-36 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The hypothesis advanced to account for the bright clouds near Antares, observed by D.S.Evans (1952) — namely, that these are clouds of condensed quartz crystals reflecting the light of the parent body — does not seem to be in conflict with either thermodynamic or optical criteria. D.R.Barber

523.161

1785. ON THE POSSIBLE ROLE OF SOLID PARTICLES IN THE SYSTEM OF EPSILON AURIGAE. Z.Kopal.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 241-50 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). It is concluded that, although undoubtedly present, the observed circumstellar gas cannot have a sufficiently high density to produce non-selective absorption of a degree to account for the observed light minima of ϵ Aurigae every 27 days; and that therefore these minima are due to non-selective extinction by solid particles of unknown origin, dispersed to form a flat ring around the secondary component, and inclined to the orbital plane of the two components of the eclipsing system. D.R.Barber

523.161

1786. NOTE ON SMALL DARK CLOUDS. A.D.Thackeray.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 437-40 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Within a field of small, dark clouds projected against, and partly within, the emission nebulosity forming part of IC 2944, a star situated just outside the edge of the largest clouds has, according to photographs obtained in 1950 May and 1954 May, become fainter by at least 2.5 mag. in this interval. It is suggested that the star is being obscured by the edge of the dark cloud. D.R.Barber

523.161

1787. DUST AND STAR FORMATION IN SUPERNOVA EXPLOSIONS. E.Öpik.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 634-7 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The radiation pressure of a cataclysmic outburst like that of a supernova, acting on the interstellar dust, will produce thin, dense shells, the sheet of dust-concentration moving gradually outwards. When overtaken by the gaseous envelope from the parent star, the sheet will act as a centre for nucleation, with the formation of an expanding association of discrete stars. D.R.Barber

523.161

1788. THE CONTRACTION OF DENSE CLOUDS OF GAS AND DUST. E.L.Rouskol.
Mem. Soc. Roy. Sci. Liege, Vol. 15, Special No., 650-65 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). From theoretical considerations it is deduced that the most probable mechanism for the formation of dense clouds of interstellar gas is by freezing down of the gas on dust particles (contraction) whenever the gaseous mass of the cloud is sufficiently large. For condensations of size about 0.1 psc. the limiting mass will be 10 ⊙, but for a size about 0.02 psc. a mass of 1 ⊙ will suffice. D.R.Barber

523.161

1789. POSSIBLE OBSERVATION OF MONOCHROMATIC RADIOEMISSION FROM INTERSTELLAR MOLECULES. I.S.Shklovsky.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 675-7 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Predicted wavelengths of three lines in the radio-spectrum are tabulated. The lines may arise from permitted transitions between the components of Λ doubling for the ground-rotational states of the three interstellar molecules, OH, CH and SiH. For a mean molecular concentration of 3×10^{-8} cm^{-3}, and the expected probability of transition, 10^{-9} sec^{-1}, these lines should be detectable. D.R.Barber

523.161

1790. COSMIC DUST AND THE ORIGIN OF STARS. A.I.Lebedinsky.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 678-81 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). A theoretical discussion of the process of star-formation in relation to the balance of interstellar gas, and dust, in diffuse nebulae. Dwarf stars originate by gravitational condensation to form bodies of mass up to 5 M ⊙, and hot, giant stars derive from these dwarf stars in cold nebulae by an accretion process. Diffuse matter is continually used up in these concurrent processes; but the loss is off-set by ejection of fresh material during the evolution of each star as the result of corpuscular radiation. A certain average concentration of discrete matter, denoted by the critical density value, is thus maintained automatically. D.R.Barber

523.161 : 523.872

1791. SHORT-PERIOD CHANGES IN THE SPECTRUM OF T TAURI. E.B.Weston and L.H.Aller.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 251-5 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Conspicuous spectral changes occur in this star within as short a period as 24 h. and minor changes within a period of about 5 h. Such changes may perhaps be attributed to the infall of interstellar material. D.R.Barber

523.162.1

1792. THE POLARIZATION OF LIGHT FROM STARS BEHIND FILAMENTARY STRUCTURE. J.S.Hall.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 543-6 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). From a detailed photoelectric study of the polarization of light from stars within, and behind, the Pleiades cluster, polarization has been detected in 6 field stars, and in 4 cluster members. The existence of unpolarized members in the same region confirms that some cluster stars lie in front of the polarizing material, and some behind it. It appears that this material is closely associated with the particles which reflect the light from the bright stars. Further, the observed planes of polarization for both cluster and background stars fit a general pattern related to the changes in orientation of the filamentary structure associated with Merope. D.R.Barber

523.162.1

1793. THE POLARIZATION OF STAR LIGHT IN SELECTED AREA 40. A.Behr.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 547-50 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The most striking result found from a polarimetric survey of the selected area 40 in Cygnus is the alignment of the plane of vibration in a direction from S. to N. High polarization is present near the W. boundary of the dark lane, where a fine filamentary structure is found to be approximately parallel to the plane of vibration. No adequate explanation of the observed alignment is possible without further investigation. D.R.Barber

523.162.1

1794. STUDY OF THE BRIGHTNESS AND POLARIZATION OF EIGHT DIFFUSE NEBULAE. M.T.Martel.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 551-6 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The objects measured from photographs taken with either an Öhman- or Lyot-type polarigraph were: NGC 7023; IC 1287; IC 348; NGC 6589; IC 1284; IC 4601a; IC 4601b and BD −19 4357. Values of radial polarization ranging from 0 to 40% were found. In most cases, a correction could be applied for the effect of the superimposed skylight. D.R.Barber

523.162.1

1795. STUDY OF THE POLARIZATION OF THE LIGHT OF GLOBULAR CLUSTERS. J.Blamont and G.Courtès.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 557-60 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The results for 28 clusters, corrected for sky polarization, are tabulated; and analysed in relation to interstellar reddening. All the clusters used as distant light-sources, yield either zero, or very small values of p, the interstellar polarization, when compared with the measures derived from observation of relatively-near stars in, or near, the galactic plane. There is no positive correlation of p with E, the colour-excess. D.R.Barber

523.162.1

1796. THEORIES OF INTERSTELLAR POLARIZATION. L.Davis, Jr.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 584-90 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). A critical summary of the present state of knowledge. Since none of the theories proposed to date is adequate from all aspects, it is suggested that a new approach is needed via paramagnetic absorption theory; supplemented by an extensive programme of new observations of polarization, colour excess and exact orientation of the plane of vibration for stars in a number of different regions. The data should then be compared with the actual distribution predicted from the combined effect of several clouds in which the polarization is dependent on a magnetic field of reasonable assumed structure. Such a comparison might show the most probable magnetic field to be one aligned along the spiral arms of the galaxy. D.R.Barber

523.162.1

1797. THE POLARIZATION OF LIGHT BY GRAPHITE POWDERS; AND THE INTERSTELLAR POLARIZATION. E.Schatzman and R.Cayrel.

Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 601-7 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Since graphite exhibits strong magneto-optical anisotropy, a fine powder placed in a weak magnetic field will show dichroism. Thus a relatively small fraction (1 : 20) of an interstellar dust composed of graphite, or similar material, could suffice to produce the observed polarization of starlight. D.R.Barber

523.164.4

1798. RADIOASTRONOMY AND THE ORIGIN OF COSMIC RAYS. V.L.Ginsburg.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 682-3 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). It is shown that the main portion of galactic radio-emission cannot be due to the supposed large collection of radio-stars; but is, in fact, caused by a general emission of cosmic electrons travelling through interstellar magnetic fields of strength about 10^{-5} oersted or less. A similar mechanism can explain the observed emission from powerful discrete sources. The most probable sources of cosmic rays are the supernovae, and related stars with turbulent envelopes. D.R.Barber

523.164.4

1799. THE MEASUREMENT OF THE ANGULAR DIAMETER OF TWO INTENSE RADIO SOURCES. I. A RADIO INTERFEROMETER USING POST-DETECTOR CORRELATION. R.C.Jennison and M.K.Das Gupta.
Phil. Mag. (Ser. 8), Vol. 1, 55-64 (Jan., 1956).

A description of a practical interferometer system based on the principle of post-detector correlation is followed by a short account of an instrument incorporating this principle. This instrument has been used at Jodrell Bank for measurements of the angular diameters and structures of the radiation from the quiet sun and the sources Cygnus and Cassiopeia. The method of computing the results is indicated, and a short account is given of a synthetic source which is used to calibrate the equipment. Reference is made to a method of obtaining the gradient of the correlation function by the use of three adjacent operating frequencies. The results of the measurements on Cassiopeia and Cygnus are given in Pt II (see abstract following). A.

523.164.4

1800. THE MEASUREMENT OF THE ANGULAR DIAMETER OF TWO INTENSE RADIO SOURCES. II. DIAMETER AND STRUCTURAL MEASUREMENTS OF THE RADIO STARS CYGNUS A AND CASSIOPEIA A. R.C.Jennison and M.K.Das Gupta.
Phil. Mag. (Ser. 8), Vol. 1, 65-75 (Jan., 1956).

An account is given of the application of the post-detector interferometer to measurements of the radio stars Cygnus A and Cassiopeia A. An outline of the experimental procedure and results is followed by a brief comparison of the photographic and radio frequency distribution of intensity of each source. A.

523.164.4

1801. ABSORPTION OF 3.5-m RADIATION IN THE OPTICAL EMISSION NEBULA NGC 6357. B.Y.Mills, A.G.Little and K.V.Sheridan.
Nature (London), Vol. 177, 178 (Jan. 28, 1956).

In a radio-survey (at 3.5 m) of 14 bright emission nebulae, NGC 6357 was observed in absorption for the first time. The observed apparent brightness temperature was $7800 \pm 1600^{\circ}$K, with an estimated electron temperature of 6500°K, similar in order of magnitude to that usually associated with optical emission nebulae. D.R.Barber

523.164.85

1802. CHARACTERISTICS OF RADIO ECHOES FROM METEOR TRAILS. II. THE DISTRIBUTION OF METEOR MAGNITUDES AND MASSES. I.C.Browne, K.Bullough, S.Evans and T.R.Kaiser.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 83-97 (Jan., 1956).

For Pt I, see Abstr. 2309 (1948). Magnitude and mass distributions are deduced from radio echo data for sporadic meteor showers. The frequency of sporadic meteors is found to increase by 2.5 times per unit increase in magnitude over the range 0^m-10^m. This corresponds to an inverse square law for the differential mass distribution. Results obtained for shower meteors in the magnitude ranges 0^m to 2^m and 5^m to 7^m cannot in general be represented simply by an inverse power law of meteor masses with constant exponent s. The Arietids are found to have s greater than 2 over the whole range of magnitudes investigated whereas the Perseids, Quadrantids and Geminids appear to have s less than 2 for the faint and s greater than about 2 for the bright meteors. It is concluded that the greater part of the total meteoric mass is contributed by the following ranges of magnitudes: Arietids, fainter than 7^m; Perseids, Quadrantids and Geminids, 2^m to 5^m. In the case of the Geminids, the concentration of meteoric mass into this magnitude range appears to increase during the course of activity of the shower. Good agreement is found between radio, telescopic and visual data. A.

523.164.85

1803. CHARACTERISTICS OF RADIO ECHOES FROM METEOR TRAILS. IV. POLARIZATION EFFECTS. E.R.Billam and I.C.Browne.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 98-113 (Jan., 1956).

For Pt III, see Abstr. 3213 (1952). Observations have been made of radio echoes from meteor trails at 55 Mc/s in order to test the theoretical estimates by Kaiser and Closs (Abstr. 1400/1952) of plasma resonance effects. The aerial array consisted of two Yagis mounted with mutually perpendicular planes of polarization on a common axis. The polarization effects observed are in good agreement with prediction for both short and long duration echoes, but some unexpected results were obtained for meteor trails with line densities in the transition region of 10^{12} electrons cm^{-1}. Some calculations have been made of the effect of the finite meteor velocity upon observed polarization effects, and are in good agreement with observation. In addition to the polarization measurements, the relationship between the amplitude A and duration T of long duration echoes was investigated. An empirical relation of the form "A is proportional to $T^{0.3}$" was found, in contrast to the predicted law "A is proportional to $T^{3/16}$". It is suggested that the discrepancy is a result of diffusion by turbulence in the atmosphere. A.

523.165

1804. SEARCH FOR POINT SOURCE OF COSMIC RAYS. Y.Sekido, S.Yoshida and Y.Kamiya.
Nature (London), Vol. 177, 35-6 (Jan. 7, 1956).

A position on the celestial sphere $\delta = 0^{\circ}$, $\alpha = 5$h. 30 min. has been confirmed to show a high cosmic-ray intensity. It is concluded that this position constitutes a point source of cosmic-rays. The count at the position is $N = 1264$ while the average of seven positions near it is $N_0 = 1091.6$. No point source apart from this is found if fluctuations less than 2.5 standard deviations are regarded as insignificant. It is estimated that the point source contributes 0.016% of the total cosmic radiation in the same energy region. The angular width of the source is estimated to be not more than 5°. The cosmic-ray increase at the position was observed at both azimuths. E.W.Kellermann

523.5

1805. THE MASSES OF METEORS. E.Öpik.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 125-46 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Data connecting the dependence of meteor heights on their observed velocity, brightness and angle of incidence,

suggest that the naked-eye meteors belong predominantly to a type for which the mean density is much lower than that of the minerals of which they consist. Their masses cannot therefore be computed satisfactorily from aerodynamic considerations; they must be based solely on radiation data. D.R.Barber

523.5 : 523.4

1806. ROLE OF METEORIC MATTER IN THE PROCESS OF SURFACE FORMATION OF SATELLITES AND MINOR PLANETS. V.V.Sharonov and N.N.Sytinskaja.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 673-4 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). It is suggested that the surface nature of satellites and minor planets is determined mainly by meteoric bombardment associated with a wide range of particle sizes. As a direct result, localized disruption of the surface material takes place, with the formation of two distinct types of surface structure at the site of the explosion. These are recognized as (i) a powdery (dust) layer, dark in colour e.g. portions of the lunar surface, and (ii) a fused, bubble-like layer, light in colour e.g. the first and second satellites of Jupiter. D.R.Barber

523.57 : 535.333

1807. SOME NEW EXPERIMENTAL RESULTS ON THE SPECTRUM OF CARBON OBTAINED IN THE LABORATORY. R.Herman and L.Herman.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 352-9 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The Baldet-Swings system of bands around 4050 A have been photographed, and new intensities are derived for the individual bands appearing in cometary spectra, e.g. at 4050 A, 4073 A : 4018 A, 4041 A, 4067 A: and 3991 A, 4013 A, 4038 A. In the latter three bands, the cometary spectra are enhanced relative to the laboratory source. D.R.Barber

523.59

1808. FLUCTUATIONS OF THE ZODIACAL LIGHT. D.Barbier.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 55-71 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The results of records made in blue and violet light with an automatic photoelectric photometer are discussed and compared with the similar measures of Elvey and Roach (1937), and Roach, Pettit, Tandberg-Hanssen and Davis (1954). There is no systematic difference between morning and evening Z.L.; and it is concluded that the short-period, day-to-day fluctuations observed at about 40 degrees from the sun are probably spurious. D.R.Barber

523.59

1809. ON THE POLARIZATION OF THE ZODIACAL LIGHT. H.C.van de Hulst.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 89-95 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The exact polarization of the dust-component of the Z.L. is not known; but it may range from +0.15 to −0.15, according as different assumptions as to size and composition of the dust grains are made. Because of this uncertainty, it is not possible to obtain a brightness value for the electron-component of the Z.L. Thus the electron density of interplanetary space must remain uncertain also. D.R.Barber

523.59

1810. OBSERVATIONS OF THE ZODIACAL LIGHT AT JUNGFRAUJOCH AND THEORETICAL COMMENTS. H.Siedentopf.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 96-9 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Recent photoelectric measures of brightness and polarization of the Z.L. indicate asymmetry in the distribution of light-intensity with respect to the ecliptic, and a symmetrical distribution of the degree of polarization. Calculations of back-diffraction from low-albedo particles, with a distribution-function of the radii with exponent between 2 and 3, yield brightness and diameter values commensurate with those observed for the counterglow, thus suggesting its origin in a pure diffraction effect. D.R.Barber

523.59

1811. QUANTITATIVE ESTIMATE OF FREQUENCY AND MASS DISTRIBUTION OF DUST PARTICLES CAUSING THE ZODIACAL LIGHT EFFECT. H.K.Kallman..
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 100-13 (1955)

Solid particles in stars colloquium paper, see Abstr. 872 (1956). From an estimate of the number of meteors, and amount of meteoric dust entering the earth's atmosphere per day, and the van de Hulst number-distribution as a function of radii for the Z.L., a comparison is made of the two types of dust, between 1 and 250 micron particle-size. The differences are found to be so large as to imply that interstellar space must contain two different types of particle of similar density, but of different origin. D.R.Barber

523.59

1812. THE CAPTURE OF ZODIACAL DUST BY THE EARTH. C.de Jager.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 174-82 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). To account for the excess observed deposit of extra-terrestrial dust on the earth (factor, 10^3) over that expected on the basis of meteor frequencies, it is suggested that zodiacal dust is captured also over an effective diameter of about 8×10^6 km, as the result of in-spiralling of matter under the influence of the solar Poynting–Robertson effect. Taking this process into account, the computed fall between 1.6 and 9×10^9 g/day is in satisfactory agreement with the observed amount. This implies that the assumed model of the zodiacal dust-cloud, with particles moving in circular orbits around the sun, must be correct. D.R.Barber

523.746

1813. THE EAST–WEST ASYMMETRY IN THE FORMATION OF NEW SUNSPOTS. M.d'Azambuja.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1712-14 (Dec. 14, 1955). In French.

Approximately twice as many new centres of spot activity are formed on the E half of the solar disk as appear on the W half; and, on the average, their life-times are longer. D.R.Barber

523.752

1814. CORRELATION PATTERNS IN THE CHROMOSPHERIC GRANULATION. J.T.Jefferies and R.E.Loughhead.
Nature (London), Vol. 177, 180-1 (Jan. 28, 1956).

Uberoi's method (1955) of measuring the spatial correlation pattern of the brightness of neighbouring regions of the solar photosphere is applied to the chromospheric granulation pattern in H-alpha light obtained with a Lyot filter of bandwidth, 0.7 A. The measured correlation is valid for separation distances up to about 3×10^4 km, i.e. the mean linear dimension of the larger cells in the observed chromospheric fine-structure, which have life-times of up to five or six hours duration. D.R.Barber

523.77

1815. AN EXPLANATION OF THE RED SHIFT IN THE SOLAR SPECTRUM. E.H.Schröter.
Naturwissenschaften, Vol. 42, No. 23, 623-4 (1955). In German.

To account for the discrepancies in observed values of red shift for the solar Fraunhofer lines with those computed from relativity theory, a disturbing influence of the convective mechanism responsible for granulation is invoked which pro-

duces asymmetry of the line profiles. A somewhat similar mechanism may explain also the observed centre-to-limb variation of the red shift, the separate deviations from the cosine-law for line profile and continuum, respectively, being different in magnitude. D.R.Barber

523.852.21

1816. INTERFERENTIAL STUDY OF H II REGIONS: INTERNAL MOVEMENTS AND DARK NEBULAE. G.Courtès.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 453-7 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Photographs of filamentary structures in H II regions of nebulosity, made with a 5-layer Couder-type dielectric filter isolating Hα radiation, reveal internal velocity-differences from 10 to 40 km/sec. D.R.Barber

523.855 : 523.112

1817. ON THE PROBABILISTIC THEORY OF CLUSTERS OF GALAXIES AND THE VERIFICATION OF THE HYPOTHESIS OF THE EXPANSION OF THE UNIVERSE. J.Neyman.
Ann. Inst. Poincaré, Vol. 14, No. 3, 201-44 (1955). In French.

In the first section, the statistical theory of the spatial distribution of galaxies, developed by the author and E.L.Scott (Abstr. 2155/1953) for a stationary universe, is extended to the case of an expanding system of galaxies. Detailed consideration is given to the possibility of distinguishing between a static and an expanding system by counts of galactic images on photographic plates. In the second section, formulae are derived for the probability of the interpenetration of galactic clusters (see Abstr. 3041/1954). R.A.Newing

523.872

1818. RELATIVE SPECTRAL GRADIENTS OF SEVERAL COOL CARBON STARS IN THE BLUE AND VIOLET REGIONS. A.McKellar and E.H.Richardson.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 256-75 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Relative spectral gradients between 3900 A and 4900 A have been determined for 10 late N-type stars. The intensity scale used was linked to curves of black-body radiation via the A-type gradient of α Lyrae. The similarity in profile of the stellar continua in the far violet with the continuum found in the laboratory by Phillips and Brewer (1954), and attributed by them to the C_3 molecule, suggests that the presence of this continuum may account completely for the strong violet stellar absorptions. D.R.Barber

523.872

1819. THE SPECTRA OF AM CEN AND GP ORI, AND THE OPACITY IN THE VIOLET REGION OF N-TYPE STARS. M.W.Feast.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 280-6 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). In this paper the strong violet opacity in N-type stellar spectra is re-discussed in the light of recent observations of the peculiar stars, AM Cen and GP Ori. Since these stars are both normal late N-type stars, and therefore not sufficiently cool for the C_2 molecules to be drastically depleted by particle formation, another possible source of the violet absorption is suggested in the molecule NaH. D.R.Barber

523.872

1820. COLOR- AND LIGHT-INTENSITY DISTRIBUTION IN THE CENTRAL REGION OF M 31. G.Thiessen.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 411-13 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Photoelectric observations of the intensity and distribution of light in two spectral ranges centred at 4100 A and 5300 A indicate: (i) a symmetrical distribution of blue light only, about the minor axis of the nebula up to a distance of 60 seconds of arc from centre; (ii) a remarkable dissymmetry of colour distribution on the photoelectric (PV) system in the sense that, for equal angular distances from centre, the NW side is bluer than the SE. D.R.Barber

523.872

1821. INTERPRETATION OF THE SPECTRUM OF THE ORION NEBULA. M.J.Seaton.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 462-79 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). This object is in a region of high dust concentration giving reddening, dark markings and reflection nebulosities. However, the greater part of the continuous spectrum is due to atomic processes, and not to dust reflection; this requires the nebula to be surrounded by a H I region some 4 pscs. in extent with 200-1000 H atoms/cm^3. D.R.Barber

523.877

1822. A STUDY REGARDING THE LUMINOUS RINGS OBSERVED TO SURROUND SOME NOVAE. E.Vandekerkhove.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 498-529 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). Relationships are established between the following parameters: distance of the nova, A; radius of the thin, spherical shell of scattering particles, a; observed angular radius of the nebulous ring, ω; and time elapsing between outburst of nova and observation of ring, t. For A/a = 40, a ratio applicable to Nova Persei (1901), the luminosity of the ring is found to remain constant up to a limiting radius of 20 minutes of arc, on the assumption that the mean diameter of the scattering particles is about 500 A. D.R.Barber

529.1

1823. DEFINITION OF THE SECOND OF TIME. H.Spencer Jones.
Nature (London), Vol. 176, 669-70 (Oct. 8, 1955).

The second of Ephemeris time has been defined by resolution at the General Assembly of the I.A.U. (Sept. 1955) in terms of the length of the tropical year for 1900·0. This note considers the relation of the second so defined to that based on mean solar or Universal time. The caesium atomic standard developed at the N.P.L. (Bullard, Abstr. 104/1956) should ultimately help to relate the mean solar second to the fundamental unit of time. G.M.Brown

PHYSICS 53

53 : 371.12

1824. SOME DETERRENTS TO EFFECTIVE TEACHING. V.W.Voeks.
Amer. J. Phys., Vol. 24, No. 2, 111-14 (Feb., 1956).

Reports a statistical analysis of comments by university students on their teachers.

53 : 62

1825. PHYSICS IN ENGINEERING. W.V.Houston.
Amer. J. Phys., Vol. 23, No. 9, 610-14 (Dec., 1955).

The application of discoveries made in pure science to engineering problems is described and illustrated by incidents in the history of submarine telegraph cables, radio communication and electronics. A.

53 : 62 : 378

1826. PROGRESS REPORT ON PHYSICS IN ENGINEERING EDUCATION. R.J.Seeger.
Amer. J. Phys., Vol. 24, No. 2, 70-7 (Feb., 1956).

This report reviews the activities of physics and engineering groups concerned recently with the problem of the role of physics in engineering education. In particular, it describes briefly the interest shown in physics education by the Committee on the Evaluation of Engineering Education of the American Society for Engineering Education, the activities of the American Association of Physics Teachers through its Committee on Engineering Education and the consideration given the whole problem by the American Institute of Physics through a special committee. Other pertinent material such as the ASEE-NSF sponsored conferences on various aspects of physics in engineering education are included. A.

53.084

1827. CONSTRUCTIONAL COMPONENTS IN PHYSICAL TECHNOLOGY. (Bauelemente der physikalischen Technik). M.Pollermann.
Berlin, Gottingen, Heidelberg: Springer-Verlag (1955) viii + 276 pp. In German.

Invaluable to the technician and research worker concerned with the design, construction and functioning of physical apparatus. The numerous components chosen from a wide range of recent research apparatus and physical instruments are illustrated by 1048 clearly drawn dimensional and sectional line drawings. After chapters dealing with materials, joints, mechanical and fine motion, separate sections are devoted to vacuum technology, electrical, optical and radiation instrumentology. Mainly German standards and sizes are quoted but nearly 300 of the approximately 450 literature references are to articles in the Review of Scientific Instruments. S.Weintroub

53.087.9 : 535.81

1828. AN OPTICAL SF □-SCALER. D.W.Hoyte.
J. sci. Instrum., Vol. 32, No. 12, 460-3 (Dec., 1955).

The instrument described will rescale and print a transparency in one direction only over a continuous range. Its use is demonstrated for the re-proportioning of instrumental records taken on film, the illustrations to technical journals, or fashion photographs; and for giving trimetric projections of curves from their plan or elevation views, and streoscopic pairs of these, including panormic views from contour maps. A.

FUNDAMENTALS 530.1

530.1

1829. A.S.EDDINGTON'S E-NUMBERS. A.Deprit.
Ann. Soc. Sci. Bruxelles I, Vol. 69, No. 2, 50-78 (1955).

The numbers are of major importance in Eddington's work "Fundamental Theory". They are here related to generalized sedenion algebras. These algebras are defined (over a commutative ring) and some of their properties are investigated. They are used to investigate the structure of the algebra of the Dirac group, and to show that Eddington's interpretation of Dirac's wave equation assumes a four-dimensional vector space which is both affine and metric. Some other results of Eddington are clarified. L.S.Goddard

530.1

1830. INVERSION OF THE COMPOSITION PRODUCT IN PHYSICS. M.Tournarie.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1923-5 (Dec. 19, 1955). In French.

The product arises in the study of the response of a linear system to a signal. This always involves a perturbation and a method is indicated for eliminating the effect of the perturbation. It is a matrix method involving the "support" of the signal. L.S.Goddard

530.12

1831. MAXWELL'S FIELD IN THE EINSTEIN UNIFIED FIELD THEORY. V.Hlavatý.
Nieuw Arch. Wiskunde, Vol. 2, 103-14 (1954).

The main result is that the unified theory admits exactly one skew-symmetric tensor function, $m_{\lambda\mu}$, of the fundamental tensor that satisfies the Maxwellian equations. Mathematical Reviews

530.12

1832. THE ELEMENTARY BASIC PRINCIPLES OF THE UNIFIED THEORY OF RELATIVITY. II. APPLICATIONS. V.Hlavatý.
J. rational Mech. Anal., Vol. 3, 645-89 (1954).

An extension of earlier work (Abstr. 5517/1952), the results being generalized by using a new structural condition. The theory is applied to celestial mechanics. The world lines of photons yield the same deflection of light and the same red shift as in classical relativity; but planetary orbits are not the same. Mathematical Reviews

530.12

1833. REPORT ON THE RECENT EINSTEIN UNIFIED FIELD THEORY. V.Hlavatý.
R.C. Sem. Mat. Univ. Padova, Vol. 23, 316-32 (1954).

A clear and useful summary of the main results of 13 earlier papers. Mathematical Reviews

530.12

1834. COMPATIBILITY OF THE EQUATIONS OF THE UNITARY THEORY OF THE EINSTEIN FIELD. A.Lichnerowicz.
J. rational Mech. Anal., Vol. 3, 487-521 (1954). In French.

A variational principle is used to derive the fundamental equations of the recent Einstein unified theory, and a certain Cauchy problem is solved. The solution is interpreted in terms of the gravitational field. Mathematical Reviews

530.12

1835. WHITEHEAD'S LAW OF GRAVITATION IN A SPACE–TIME OF CONSTANT CURVATURE. C.B.Rayner.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 944-50 (Nov., 1955).

A generalization of Whitehead's law of gravitation for a discrete set of particles having arbitrary world-lines in a flat background space–time is formulated for a space–time of constant curvature. It is then extended by a method of Synge (Rayner 1954) to include systems having finite and continuous proper-density and velocity distributions. The new law is particularly adapted to a cosmological theory like that previously considered by the author in which every gravitating particle recedes with uniform velocity from a common spatio-temporal origin. A.

530.12

1836. THE EQUATIONS OF MOTION OF ROTATING BODIES IN GENERAL RELATIVITY. J.H.Haywood.
Proc. Phys. Soc. A, Vol. 69, Pt 1, 2-15 (Jan., 1956).

The equations of motion are derived of two rotating bodies moving in the weak and quasi-static gravitational field of the bodies up to terms of the order $(v/c)^3$. The analysis is used to obtain the equations of motion of: (a) rotating bodies which remain spherically symmetric, (b) rotating fluid bodies which become spheroidal in form. In case (a) the equations of motion of one body depend directly on the rotation of the second body but not on its own rotation. In case (b) the equations of motion of the one body contain terms due to its own rotation which are dependent on its density distribution. A.

530.131 : 531.62

1837. ON THE PHYSICAL AND LOGICAL FOUNDATIONS OF THE LAW OF THE CONSERVATION AND TRANSFORMATION OF ENERGY. St.G.Christoff.
Izv. Bulg. Akad. Nauk , Vol. 4, 293-360 (1954; publ. 1955). In Bulgarian with summaries (4½ pp.) in Russian and (4½ pp.) in German.

The discussion is based on the author's previous consideration of the relation between energy and motion (Mitteilungen des Philosophischen Instituts bei der Bulgarischen Akademie der Wissenschaften, Vol. 1, 1954). The law is formulated without the introduction of the mechanical concepts of work and force and is derived by a direct analysis of purely experimental processes. S.Weintroub

530.145

1838. AN ATTEMPT TO EXPRESS THE PAULI PRINCIPLE AS AN "EXCLUSIVE FORCE". NUMERICAL COMPARISON WITH THE CLASSICAL ELECTRIC FORCE. C.Vroelant, A.Laforgue and J.-L.Masse.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1265-6 (Nov. 7, 1955). In French.

530.145

1839. TRANSVERSE RELAXATION AND CORRELATION FUNCTION OF A QUANTUM VARIABLE. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 241, No. 21, 1450-2 (Nov. 21, 1955). In French.

A general method is given for treating the "transverse relaxation" of a system (i.e. relaxation involving no exchange of energy and determined by the non-diagonal elements of the density matrix). The method is valid for energies small compared with kT, and it corresponds to Ayant's treatment of the correlation function associated with a quantum variable. (Abstr. 6727/1955). E.H.Sondheimer

530.145

1840. Ψ SUPERPOSITION AND QUANTUM RULES. A.Landé.
Amer. J. Phys., Vol. 24, No. 2, 56-9 (Feb., 1956).

The superposition rule for probability amplitudes ψ is not a separate ad hoc assumption of a physical character but is a formal consequence of the arrangement of the states of a system in sets of mutually orthogonal states linked by probabilities of transition. Nor do the quantum prescriptions of Born and Schrödinger have to be introduced as ad hoc assumptions; they can be deduced as consequences of (a) the superposition rule, and (b) the definition of conjugates q and p as leading to a constant probability density in qp-space, a quality known from classical statistical mechanics. Quantum theory can thus be deduced from a non-quantal background. A.

530.145 : 530.12

1841. REMARKS ON A UNITARY VARIATION PRINCIPLE FOR THE FUNDAMENTAL LAWS OF MECHANICS, ELECTRODYNAMICS AND GRAVITATION. E.Schmutzer.
Z. Phys., Vol. 143, No. 4, 479-88 (1955). In German.

An attempt is made to set up a Lagrange density of the general form $(R/2\kappa) + \beta u^i v_i + U_{\alpha i} v^{\alpha i} + 4\Psi$ from which the three sets of laws may be derived without the introduction of supplementary conditions. It is shown that a variation principle of this type may be made to give simultaneously the Klein–Gordon equation, the electromagnetic field equations and Einstein's equations for the gravitational field. R.A.Newing

530.145

1842. VARIATIONAL PRINCIPLES FOR ELECTROMAGNETIC FIELDS. A.M.Pratelli.
Ann. Scuola Norm. Super. Pisa, 7 (1953); 161-203 (1954). In Italian.

The basic idea is the decomposition of a vector field into an irrotational part and a solenoidal part, and B.Finzi's generalization of this to the similar decomposition of a skew-symmetric tensor field. The method is extended to a certain 5-dimensional manifold, and it is applied to scalar and vector meson fields. Mathematical Reviews

530.145

1843. INTRODUCTION TO QUANTUM ELECTRODYNAMICS (Einfuhrung in die Quantenelektrodynamik). W.Thirring.
Vienna: Franz Deuticke (1955) xii + 122 pp. In German.

Review in Brit. J. appl. Phys., Vol. 6, No. 11, 410 (Nov., 1955).

530.145

1844. SMALL OSCILLATION THEORY OF THE INTERACTION OF A PARTICLE AND SCALAR FIELD. E.P.Gross.
Phys. Rev., Vol. 100, No. 6, 1571-8 (Dec. 15, 1955).

The interaction of a nonrelativistic particle with a scalar field, with particular application to the theory of polarons, is studied. The approach is based on a general classical method for the integration of equations of motion. The Hamiltonian is transformed by successive canonical transformations, the first corresponding to describing the motion relative to special solutions of the equations of motion. This stage as applied to suitably ordered Heisenberg equations of motion is identical with intermediate coupling theory. The second transformation treats the coupled small oscillations of particle and field oscillators about the chosen special solution. This affords a natural extension of intermediate coupling theory for this problem. Differences between the classical and quantum theories arise in the ordering of operators; the differences play a crucial role in determining the effective cut-off in wave vector space. A.

530.145

1845. RENORMALIZATION CONSTANTS. Y.Nambu.
Phys. Rev., Vol. 101, No. 3, 1183-6 (Feb. 1, 1956).

From a study of the formulae which relate Dyson's renormalization constants to the spectral functions introduced earlier, it is shown that the charge (coupling) renormalization constant Z_1 must be zero. The symmetrical pseudoscalar meson theory is taken as an example, but the result is not necessarily restricted to this case only. A.

530.145

1846. NEW APPROACH TO THE MANY-BODY PROBLEM. G.J.Yevick and J.K.Percus.
Phys. Rev., Vol. 101, No. 3, 1186-91 (Feb. 1, 1956).

The dynamical behaviour of N interacting particles may be simplified by the introduction of 3N collective coordinates. A geometric interpretation of collective coordinates is described which is analogous to a type of random walk problem. Considerations on the validity of the transformation from ordinary spatial coordinates to symmetrical collective coordinates are discussed. The difficult problem of the boundary of collective coordinate space is touched upon. In the second half of the paper, the Lagrangian formulation for the dynamical problem is carried out by means of collective coordinates. Conditions for the equivalence of the physical Lagrangian and the collective coordinate Lagrangian are established. This leads to the problem of Fourier representation of a potential by a finite number of terms. Finally, preliminary remarks on a modified Dirac δ function are presented A.

530.145

1847. DYNAMICAL CONSIDERATIONS ON A NEW APPROACH TO THE MANY-BODY PROBLEM. J.K.Percus and G.J.Yevick.
Phys. Rev., Vol. 101, No. 3, 1192-7 (Feb. 1, 1956).

In Pt A, a further analysis is made of the collective coordinate Lagrangian first introduced in the preceding abstract. This Lagrangian, which replaces the physical Lagrangian, describes a set of fictitious harmonic oscillators whose masses and frequencies are established. This is accomplished by ad-

ding a term to the physical Lagrangian which, however, does not affect the equations of motion. The analysis is carried out by two distinct methods: comparison of Lagrangians and comparison of equations of motion. Both methods yield identical results. In Pt B, the difficult problem of representing the Dirac δ function by a finite number of terms is handled by the introduction of the d-function. A specific representation of this function is given, along with plausibility arguments that it satisfies the requirements of Pt A. A brief analysis and summary of the manifold properties of the d-function is presented. A.

530.145

1848. THE PRESENT STATE OF THE THEORY OF ELEMENTARY PARTICLES. W.Heisenberg.
Naturwissenschaften, Vol. 42, No. 24, 637-41 (1955). In German.

The history of the role of elementary particles is discussed, especially as connected with the development of the quantum field theories. Difficulties of these theories are noted, and possible direction in which one might go to derive the masses and charges of the particles from more basic equations are discussed. G.E.Brown

530.145

1849. A NOTE TO BHABHA'S EQUATION FOR A PARTICLE WITH MAXIMUM SPIN 3/2. M.Petráš.
Czech. J. Phys., Vol. 5, No. 3, 418-19 (Aug., 1955). In Russian.

The matrices α^k appearing in Bhabha's equation are expressed in terms of Dirac's ^{k} and Kemmer's β^k by means of relations derived in Abstr. 7692 (1955). The equations of Harish-Chandra (Abstr. 826/1948) and Minami et al. (Abstr. 77/1954) follow as special cases. A canonical equation for a spin 3/2 particle with an anomalous magnetic moment is deduced. W.J.Swiatecki

530.145

1850. THEORY OF ELEMENTARY PARTICLES. W.Heisenberg.
Science, Vol. 122, 1215-20 (Dec. 23, 1955).

A semi-popular exposition of his theory which begins from a nonlinear spinor wave equation and employs only part of Hilbert space, in order to avoid divergence troubles. G.E.Brown

530.145

1851. STRANGE PARTICLES AND THE CONSERVATION OF ISOTOPIC SPIN. K.M.Case, R.Karplus and C.N.Yang.
Phys. Rev., Vol. 101, No. 2, 874-6 (Jan. 15, 1956).

The question is considered as to whether complete rotational symmetry in isotopic spin space is necessary. In particular, the classification of elementary particles on the basis of the representations of a finite group is attempted. It is found that for the particles whose reactions are known, the law of conservation of charge results in a scheme essentially equivalent with ones previously proposed. However, some additional freedom is found which would accommodate particles with rather unusual properties if such are ever observed. A.

530.145

1852. SELF-ENERGY OF DIRAC PARTICLES. K.Huang.
Phys. Rev., Vol. 101, No. 3, 1173-82 (Feb. 1, 1956).

Weisskopf's analysis of the electron self-energy in 1939 showed that the part of the self-energy that is due to the spin of the particle is negative. An extension of this analysis with the addition of a Pauli term to the Hamiltonian shows that the additional self-energy that arises is also negative and only adds to the original spin self-energy. The physical significance of this negative spin energy is discussed in detail. With the choice of an appropriate cutoff, the total self-energy of a Dirac particle with a Pauli anomalous magnetic moment can be made negative. A possible explanation of the neutron-proton mass difference in terms of their difference in electromagnetic self-energy, as first pointed by Feynman and Speisman, is considered in the light of such an analysis of the self-energy. A.

530.145

1853. ISOTOPIC SPIN OF ANTIPARTICLES. J.V.Lepore.
Phys. Rev., Vol. 101, No. 3, 1206-7 (Feb. 1, 1956).

The eigenvalue of τ_3, the isotopic spin operator describing protons and neutrons, are usually taken as +1, −1 respectively. At first sight there appears to be some arbitrariness in the corresponding assignments for antiprotons and antineutrons, since either +1, −1 or −1, +1 seem to be logical possibilities; however, it is shown that in order to construct a theory involving nucleons, mesons and the electromagnetic field which is invariant under electric charge conjugation only the first possibility is allowed. A.

530.145

1854. THE HYDRODYNAMIC THEORY OF MULTIPLE FORMATION OF PARTICLES. S.Z. Belen'kiĭ and L.D.Landau.
Uspekhi fiz. Nauk, Vol. 56, No. 3, 309-48 (1955). In Russian.

An elegant exposition by leaders in the Soviet band of theoretical physicists. Starting from the basic ideas of Fermi they go on to work out the energy and angular distributions of particles and to a study of collisions of particles with different masses. Mathematical methods are given in three appendices. 17 refs mainly Russian. C.R.S.Manders

530.145

1855. ON THE EXISTENCE OF STATIONARY QUANTUM STATES OF POINT NUCLEONS INTERACTING WITH MESON FIELDS. S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 599-604 (1955). In Russian.

Nucleons are treated in the non-relativistic approximation. A trial function is constructed and employed in a variational calculation. For a pseudo-vector interaction, the energy so obtained is $-\infty$, showing the absence of stationary states of finite energy. G.E.Brown

530.145

1856. THREE-BODY CONTRIBUTIONS TO THE TRITON BINDING ENERGY. E.M.Gelbard.
Phys. Rev., Vol. 100, No. 5, 1530-8 (Dec. 1, 1955).

A variational calculation shows that the central part of the Lévy potential is not sufficient to bind the triton. One finds a bound S-state wave function only if the coupling constant is increased appreciably. Using wave functions determined in this way, the author has computed the binding energy contributed by five three-body terms, derived from the ps—ps theory. Results of this calculation indicate that the so-called "leading" three-body term is not the dominant term, even if damping is taken into account. The total contribution of the potentials considered here is attractive, not repulsive. A.

530.145

1857. TENSOR OPERATOR METHODS AND THE TENSOR FORCE. J.Hope and L.W.Longdon.
Phys. Rev., Vol. 101, No. 2, 710-16 (Jan. 15, 1956).

Tensor operator methods are applied to find matrix elements of the two-nucleon tensor force between states of two equivalent nucleons in LS coupling. The results are used to obtain the direct and exchange terms arising from a tensor-force interaction between states of a shell closed except for a single vacancy and external inequivalent nucleon. A.

530.145

1858. RELATIONS BETWEEN BOUND-STATE PROBLEMS AND SCATTERING THEORY. A.Reifman, B.S.DeWitt and R.G.Newton.
Phys. Rev., Vol. 101, No. 2, 877-9 (Jan. 15, 1956).

An operator that takes an "unperturbed" two-particle eigenvector belonging to the discrete spectrum of a potential well of finite width into that including a short-range interaction is examined in the limit as the well width tends to infinity. It is found to approach the K operator, which satisfies the integral equation using the principal value of the kernel. The result sheds light on Brueckner's equations, which can now be formulated entirely in bound-state language. The connection between forward scattering amplitude and energy shift used in a recent paper on the π-mesonic atom is also commented on. A.

530.145

1859. NUCLEON ANOMALOUS MOMENTS VIA PION—PION ATTRACTION. W.G.Holladay.
Phys. Rev., Vol. 101, No. 3, 1198-201 (Feb. 1, 1956).

The importance of a pion—pion attraction for calculating nucleon anomalous moments is emphasized. It is found that reasonably strong pion—pion attraction is capable of giving large enough moments, even if the mirror condition of Sachs is imposed. It is pointed out that many effects, such as core recoil, interaction currents, and excited cores offer no relief in calculating large enough moments. A.

530.145

1860. NUCLEON STRUCTURE AND THE n-p MASS DIFFERENCE. W.G.Holladay.
Phys. Rev., Vol. 101, No. 3, 1202-5 (Feb. 1, 1956).

The possibility of understanding the n-p mass difference by means of electromagnetic interactions among the particles of a structured nucleon is pointed out. The success of this approach depends on the same general features that seem to be necessary in understanding the nucleon moments, namely, the enhancement of the annihilation of a π^+, π^- pair. Thus, further confirmation is provided for the hypothesis of a pion-pion attraction. Information on the spatial extent of the pion cloud is obtained, namely that $\rho \cong 2.4$ nucleon Compton wavelengths, where ρ^{-3} is related to the average of the inverse cube of the distance between the pions and the core. A.

530.145

1861. THE RELATIVISTIC WAVE EQUATION OF THE NUCLEON. N.St.Kalitzin.
Acta phys. Hungar., Vol. 5, No. 1, 15-32 (1955). In German.

This is an attempt to describe the isotopic spin of the nucleon with the help of an eight-component Dirac equation in six dimensions (Cartan). However, it is not shown that the charge vanishes in the alleged neutron states; indeed, an artificial charge compensation is mentioned in the subsequent treatment of the magnetic moment. The interpretation is partly based on the statement that "for $m_0 = 0$, the true equation of the nucleon must go over into that of the meson". In analogy with the spin, an "additional magnetic moment due to isotopic spin" is invoked and made to account for the anomalous values by assigning the mass 1223 m_e to the "meson". W.A.Hepner

530.145

1862. A TYPE OF PHASE-SPACE REPRESENTATION IN QUANTUM MECHANICS. F.Bopp.
Z. Phys., Vol. 144, No. 1-3, 13-24 (1956). In German.

A contribution to the linking of quantum mechanics with the theory of stochastic processes. Various two-parameter probabilities arise in the expressions for an observable function, and most of the paper is given to the determination of these; matrix representation theory is involved. An example discussed refers to the Schrödinger equation in stochastic form. L.S.Goddard

530.145

1863. NUMERICAL TREATMENT OF COULOMB WAVE FUNCTIONS. C.E.Fröberg.
Rev. mod. Phys., Vol. 27, No. 4(I), 399-411 (Oct., 1955).

A number of methods, suitable for computation of Coulomb wave functions with high accuracy, are collected, most of them previously well known. It is shown that the regions where these methods can be used, together cover all positive values of and η in the case $L = 0$. All formulae are presented in a form well adapted for direct numerical computation. A.

530.145

1864. RESONANCE TRANSITIONS INDUCED BY PERTURBATIONS AT TWO OR MORE DIFFERENT FREQUENCIES. N.F.Ramsey.
Phys. Rev., Vol. 100, No. 4, 1191-4 (Nov. 15, 1955).

Resonance transition probabilities for a system in the presence of oscillatory perturbations at two or more different frequencies are discussed. It is shown that if resonance transitions are induced by a perturbation at one frequency, then the presence of the other perturbations at nonresonant frequencies alters the resonance frequency for the first perturbation. Theoretical expressions for the alteration of the resonance frequency are derived. Various applications of the derived formulae are discussed, including resonance experiments with more than one oscillatory field, molecular beam experiments in a nonuniform constant field, evaluation of "collision-narrowing" effects in nuclear paramagnetic resonance, etc. The effects of the extraneous oscillatory perturbations are shown to be especially important if their frequencies are close to Bohr frequencies for the perturbation. A.

530.145

1865. FORMATION OF A NON-LINEAR WAVE-MECHANICAL EQUATION IN THE THEORY OF THE DOUBLE SOLUTION. F.Fer.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1719-21 (Dec. 14, 1955). In French.

530.145

1866. REFINEMENT OF THE BRILLOUIN—WIGNER PERTURBATION METHOD. P.Goldhammer and E.Feenberg.
Phys. Rev., Vol. 101, No. 4, 1233-4 (Feb. 15, 1956).

New variational parameters are introduced into the wave function employed in the Brillouin—Wigner perturbation method, and determined to minimize the total energy. The original and modified procedures are illustrated by a numerical example. A.

530.145 : 519.2

1867. STOCHASTIC REPRESENTATION OF QUANTUM MECHANICS. F.Bopp.
Naturwissenschaften, Vol. 42, No. 19, 531-2 (1955). In German.

If in place of v.Neumann's equation, $i\hbar\dot{P} = HP - PH$ (P = statistical matrix), one uses on the right a stochastic expression, which is, however, sufficiently close to HP - PH (as specified by the smallness of a certain parameter compared to $10^{-80}\ \hbar/mc^2$ sec), then for a time of the order of 10^{18} sec the stochastic system is indistinguishable from the quantum mechanical one. W.J.Swiatecki

530.162

1868. STATISTICAL MECHANICS OF ROTATING BUCKETS. J.M.Blatt, S.T.Butler and M.R.Schafroth.
Phys. Rev., Vol. 100, No. 2, 481-95 (Oct. 15, 1955).

A system in temperature equilibrium is enclosed in a container and this container is set rotating. It is shown that the effective moment of inertia is the same as would be computed in the usual way, for both classical and quantum statistical mechanics. This apparently trivial theorem has applications for the theories of superfluidity of liquid helium and of superconductivity of metals. See following abstracts. A.

530.162 : 536.48

1869. NONEQUILIBRIUM NATURE OF THE SUPERFLUID

STATE. S.T.Butler and J.M.Blatt.
Phys. Rev., Vol. 100, No. 2, 495-501 (Oct. 15, 1955).

It is shown that the result of the preceding abstract is directly applicable to liquid helium, i.e., no superfluid state can exist in liquid helium under conditions of thermodynamic equilibrium. The observed superfluid properties of liquid helium must therefore be due to a nonequilibrium (metastable) superfluid state. Previous theoretical arguments for equilibrium superfluidity are examined, and an experimental test of nonequilibrium superfluidity is suggested. A.

530.162 : 536.48 : 537.312.62

1870. CONNECTION BETWEEN SUPERFLUIDITY AND SUPERCONDUCTIVITY. M.R.Schafroth.
Phys. Rev., Vol. 100, No. 2, 502-5 (Oct. 15, 1955).

A general connection between equilibrium superfluidity and superconductivity is established. This connection allows a previously established theorem (see abstract above) on the nonexistence of equilibrium superfluidity in actual physical systems to be applied to superconductivity. It follows that London's equations can only be approximately valid and have to be modified. An alternative equation proposed by Pippard is also in contradiction with the theorem. A.

530.162

1871. INTERACTION OF ROTATIONAL AND TRANSLATIONAL DIFFUSION. S.Prager.
J. chem. Phys., Vol. 23, No. 12, 2404-7 (Dec., 1955).

The Brownian motion of cylindrically symmetric particles is discussed, taking into account the unequal rates of diffusion parallel and perpendicular to the unique axis, as well as rotational diffusion. The problem is solved analytically for the case where the diffusing particles are initially distributed uniformly and with random orientation over a given plane. It is shown that the distribution at a later time is not strictly Gaussian, as is the case with spherically symmetric particles. On a macroscopic scale the effect is a small one. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.224.8

1872. FUNDAMENTAL BEHAVIOUR OF SENSITIVE SPRINGS. R.Tomaschek.
J. sci. Instrum., Vol. 33, No. 2, 78-81 (Feb., 1956).

It is shown that by extending a flat spiral spring by a force acting at one of its ends perpendicular or at an angle to its original winding plane, shapes of a special form, called serpent springs, can be obtained. Though capable of supporting relatively heavy loads, these springs respond under certain conditions to small changes in the loads by considerable lengthening and twisting. The conditions for obtaining such springs of high sensitivity and their fundamental behaviour are described. A.

531.259.2 : 535.55

1873. STRESS DISTRIBUTION IN A TEE JUNCTION OF THICK PIPES. H.Fessler and B.H.Lewin.
Brit. J. appl. Phys., Vol. 7, No. 2, 76-9 (Feb., 1956).

The stress distribution on the inner surfaces of both pipes near their juncture, as caused by internal pressure, was determined by the "frozen stress" photoelastic technique. An approximate method of calculation (based on the theoretical solution for a hole in an infinite plate under uniform tension) was developed and a measure of agreement between the calculated and measured stresses was found. A.

531.26 : 538.12

1874. AN ELECTROMAGNETIC MODEL FOR THE SOLUTION OF THE PROBLEM OF THE GRAVITATIONAL (OR MAGNETIC) FORCE DUE TO THREE-DIMENSIONAL BODIES OF HOMOGENEOUS DENSITY (OR MAGNETIZATION). D.Zidarov.
Izv. Bulg. Akad. Nauk., Vol. 4, 227-37 (1954; publ. 1955). In Bulgarian with summary (1 p.) in French.

The z-component of force could be determined approximately by dividing a model of the body into thin plane sections perpendicular to the z-axis and measuring the magnetic potential due to electric currents flowing round the perimeters of these sections. R.A.Newing

531.38

1875. SOME PARASITIC DEFLEXIONS IN PARALLEL SPRING MOVEMENTS. R.V.Jones and I.R.Young.
J. sci. Instrum., Vol. 33, No. 1, 11-15 (Jan., 1956).

Some parastic departures from parallel and rectilinear movement in simple and compound assemblies are analysed. The following factors are considered: accuracy of construction, geometrical proportions, spring variations, spring distortion, platform bending, clamp distortion, and gravity effects. It is shown that the "ideal" height at which to drive a parallel spring element is at half the spring height, and it is concluded that while spring tolerances are surprisingly "easy", care must be taken with the platforms and clamps if the highest performances are to be achieved. In compound movements, the possibility of "slaving" the intermediate platform, suggested by Plainevaux (Abstr. 8940/1954) has been tested in practice with good results. A.

531.38 : 534.1

1876. VIBRATIONAL DYNAMICS WITH LENSES, MIRRORS, AND PRISMS. J.Satterly.
Amer. J. Phys., Vol. 23, No. 9, 562-81 (Dec., 1955).

Experiments on the rocking of bodies using lenses are described. Their surfaces may be spherical, cylindrical, or plane, and these have the advantage that they are smooth and of good geometrical form. Their curvatures may be measured accurately with calipers and spherometer. To lenses may be added prisms and mirrors. The calculations of the period of rocking furnish, interesting examples of the applications of mechanics to vibrational problems, and the calculation of positions of centres of gravity of and values of moments of inertia provide additional exercises. The experiments are suitable for senior classes in the physical laboratory. A.

MECHANICAL MEASUREMENTS 531.7

531.714.2 : 537.312.5

1877. DYNAMIC DEFLECTION TRANSDUCER UTILIZING PHOTOCONDUCTIVE SENSORS. R.Papirno and G.Gerard.
Rev. sci. Instrum., Vol. 26, No. 10, 968-9 (Oct., 1955).

A deflection transducer for dynamic studies in which the movable element has negligible inertia is described. The sensing element utilizes a light beam incident upon a photoconductive cell which is modulated by a suitably gridded film strip attached to the specimen at the desired location. The output of the photoconductive cell circuit is a varying voltage signal applied directly to a cathode ray oscilloscope. A calibration scheme is described and the results of tests are given. The data indicate agreement within 2% over the entire calibrated range of deflections. A.

531.717.8

1878. THE ACCURACY OF OPTICAL MEASUREMENT OF RADIUS OF CURVATURE. K.Rosenhauer.
Optik, Vol. 13, No. 1, 5-6 (1956). In German.

Mechanical measurements of radius of curvature of proof plates have an accuracy of about 1×10^{-4} of the radius. An optical method is described which depends upon bringing two reflected images to coincidence, and is said to have an

accuracy of $\pm 1\ \mu$ or 1×10^{-5} of the radius of 100 mm.
R.W.Fish

531.717.81 : 535.417
CONTROL AND INTERFEROMETRIC MEASUREMENT OF PLATE FLATNESS. See Abstr. 1131.

531.74
1879. THE USE OF POLARIZED LIGHT FOR THE MEASUREMENT OF SMALL ANGULAR DISPLACEMENTS. A.J.Bartley.
J. sci. Instrum., Vol. 33, No. 1, 20-2 (Jan., 1956).

An investigation has been carried out into the use of polarized light for the measurement of small angular displacements of the order of one minute of arc. The basic technique is explained in detail and a description is given of a test rig which was built to determine the sensitivity of the method. The suitability of the system for dynamic measurements is discussed and various recommendations are made regarding possible future developments. A.

531.768
1880. SHOCK SPECTRUM COMPUTER FOR FREQUENCIES UP TO 2000 c/s. C.T.Morrow and D.E.Riesen.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 93-101 (Jan., 1956).

The shock spectrum for an acceleration impulse to an electronic equipment or other component is a measure of severity of mechanical shock in terms of possible peak response at each frequency within the component structure. It is commonly measured by a reed gauge, which is intended to simulate the possible resonant characteristics of the internal structure. The reed gauge is bulky, however, and provides data at a limited number of frequencies. The shock spectrum computer operates on an accelerometer signal, either direct or recorded, and permits measurement of as many points in the spectrum as desired. It is a device which solves the differential equation of a simple undamped resonant mechanical appendage for any applied impulse of acceleration to yield the response. In the present version, the response is made available as an output signal which is applied to a commercial cathode-ray oscilloscope. Peak accelerations and their time of occurrence may be obtained readily from the oscilloscope display. The computer can be tuned to any frequency up to 2000 c/s. Control circuitry is used to damp the computer shortly after each impulse and to undamp it immediately before the next so that the impulse under study can be applied repeatedly from a recirculating loop of magnetic tape. Shock spectra obtained from the computer and oscilloscope display are used as a measure of the severity of shocks experienced by electronic apparatus and as a basis for deriving shock specifications for use in design approval tests. A.

MECHANICS OF FLUIDS 532

532.13 : 533.15/.16 : 536.23 : 536.44
1881. PROPERTIES OF GASES AND LIQUIDS WITHIN THE RANGE OF PRESSURES USED IN INDUSTRY. E.U.Franck.
Chem.-Ingen.-Tech., Vol. 27, No. 8-9, 473-4 (Aug.-Sept., 1955). In German.

A review of 30 papers published during the last 10 years on (1) pressure–temperature–volume (P–M–V) surface, (2) critical point between the gas and liquid region, (3) viscosity and heat conductivity, (4) coefficient of diffusion and gas density, (5) binary gas mixtures, (6) abnormal increase of vapour pressures of solids in compressed gases, and (7) solubility of solids in gases. F.Lachman

532.13 : 535.551 : 537.226.3
1882. DYNAMICS OF POLYMER MOLECULES IN DILUTE SOLUTION: VISCOELASTICITY, FLOW BIREFRINGENCE AND DIELECTRIC LOSS. B.H.Zimm.
J. chem. Phys., Vol. 24, No. 2, 269-78 (Feb., 1956).

The problem of the motions of a chain molecule diffusing in a viscous fluid under the influence of external forces or currents is considered for a particular model. This model is a chain of beads connected by ideal springs. Hydrodynamic interaction between the beads is introduced in the approximate form due to Kirkwood and Riseman. It is possible to solve this problem exactly with the use of a transformation to a set of normal coordinates. The viscosity, birefringence of flow, and dielectric and tensile relaxation behaviour are calculated explicitly. The intrinsic viscosity in steady flow is somewhat different from the Kirkwood–Riseman result, and there is no change of viscosity with shear rate. The spectrum of relaxation times is similar to that found by Rouse and by F. Bueche, but has its maximum at a lower frequency than those obtained by Kuhn and Kuhn and by Kirkwood and Fuoss in other ways. A.

532.133 : 535.557
APPARATUS FOR THE SIMULTANEOUS STUDY OF STREAMING DOUBLE REFRACTION AND VISCOSITY. See Abstr. 1143.

532.5 : 530.162
1883. FINE-GRAINED AND COARSE-GRAINED LOCAL QUANTITIES, FLUCTUATIONS, DISPERSIONS AND CORRELATIONS IN STATISTICAL HYDRODYNAMICS. D.Massignon.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1259-62 (Nov. 7, 1955). In French.

Instead of representing particles by delta functions and calculating the fluctuations in macroscopic variables taken over small volumes in the neighbourhood of a point, it is shown that a representation of the particles by distributions (in Schwartz' sense) leads to similar results. This procedure is said to yield both mathematical and physical advantages.
R.O.Davies

532.517.2 : 541.182.6
1884. THE LAMINAR FLOW OF STREAMS OF SUSPENDED PARTICLES. T.V.Starkey.
Brit. J. appl. Phys., Vol. 7, No. 2, 52-5 (Feb., 1956).

It was shown theoretically in a previous paper (Abstr. 1575/1955) that during the laminar flow of a suspension through a tube, and for least action, a suspended particle would follow a path adjacent to the tube axis. In general, therefore, a particle entering a tube non-axially would be expected to move with a component of translation normal to the streamlines and directed towards the axis. In the present paper this theory is developed and leads to the conclusion that for a particle at any given point in the tube this component increases with particle size. Experiments are described in which streams of coloured particles of mixed sizes suspended in water were admitted at a given point on the horizontal diameter of a tube placed horizontally, through which a steady flow of water was maintained. These coloured streams diverged on entry to the water and formed filaments in a horizontal plane. A study of the lateral movement of these filaments relative to one another, as the point of their admission to the tube and the rate of flow of water in the tube are varied, leads to the conclusion that lateral forces act on the suspended particles. Such forces, the magnitudes of which increase with particle size and with mean shear gradient, result from the motion of the particles in non-uniform velocity gradients. The motions observed lead directly to a simple flow mechanism, independent of particle configuration and orientation, which is shown to be qualitatively consistent with a number of well-established phenomena. A.

532.517.4
1885. THE MEAN VELOCITY OF DISCRETE PARTICLES IN TURBULENT FLOW IN A PIPE. G.K.Batchelor, A.M.Binnie and O.M.Phillips.

Proc. Phys. Soc. B, Vol. 68, Pt 12, 1095-104 (Dec., 1955).

The axial component of velocity, averaged over a long time, of a material element of fluid in a straight circular pipe is shown theoretically to be equal to the discharge velocity defined as the discharge, averaged over a long time, divided by the cross-section of the pipe. This prediction was confirmed experimentally by injecting in turn into a water pipe a large number of solid spheres of different sizes having the same density as water. A satisfactory theory is developed to allow for the finite size of the spheres. The fluctuation in the time of travel of a particle between two fixed stations is examined, and it is shown how a few particles may be used to determine the discharge velocity within calculable limits of accuracy. A.

532.528 : 532.123

1886. THE TENSILE STRENGTHS OF LIQUIDS UNDER DYNAMIC LOADING. T.H.Bull.
Phil. Mag. (Ser. 8), Vol. 1, 153-65 (Feb., 1956).

A method of measuring the dynamic tensile strengths of liquids, involving the use of an electrical pressure bar, is described. Cavitation phenomena in water subjected to large transient tensile stresses have been observed using a spark shadowgraph technique. Under similar conditions of transient loading the cavitation thresholds of water and of glycerol are approximately 17×10^6 dynes/cm^2 and 63×10^6 dynes/cm^2 respectively. A.

CAPILLARITY 532.6

532.612.4 : 536.655

1887. VARIATION OF SURFACE TENSION AND HEAT OF VAPORIZATION WITH TEMPERATURE. S.T.Bowden.
J. chem. Phys., Vol. 23, No. 12, 2454-5 (Dec., 1955).

An equation is developed expressing surface tension in terms of the parachor, the molar volume at the boiling point, the b.pt. and the absolute temperature, which predicts values of surface tension within 5% of the measured values for benzene between 20 and 80°C. A similar equation for the molar heat of vaporization (same variables) gives results generally within 1% of the measured values. R.C.Murray

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

1888. THEORY OF ONE-DIMENSIONAL FLUID BINARY MIXTURES. R.Kikuchi.
J. chem. Phys., Vol. 23, No. 12, 2327-32 (Dec., 1955).

The rigorous solution of a one-dimensional fluid binary mixture with arbitrary interparticle potentials is obtained under the assumption that a particle interacts with its nearest neighbours, and that the system obeys classical statistical mechanics. This rigorous solution provides the interpretation of parameters used in the lattice model of binary mixtures. A.

532.72

1889. THERMAL DIFFUSION IN POLYMER SOLUTIONS. A.H.Emery, Jr and H.G.Drickamer.
J. chem. Phys., Vol. 23, No. 12, 2252-7 (Dec., 1955).

Thermal diffusion measurements have been made on a series of solutions of polystyrene as follows: (1) Five molecular weights (10 000 to 336 000) in toluene; (2) 136 000 molecular weight in o-xylene, styrene, ethyl benzene, dioxane and pyridine; (3) Styrene dimer in toluene and styrene; measurements were also made on some binary monomeric mixtures. The thermodynamic property $X\partial\mu/\partial X$ describes adequately the concentration dependence of the thermal diffusion ratio α. It appears that that portion of the motion of the polystyrene molecule in dilute and somewhat concentrated solutions which is segmental involves 10-13 chain atoms in the moving segment. The results seem consistent with Kauzmann and Eyring's picture for motion of long chain molecules. A.

532.73

1890. ON THE FREE ENERGY OF SOLUTIONS. S.A.Rice.
J. chem. Phys., Vol. 24, No. 2, 357-9 (Feb., 1956).

The proposal has been made that the free energy of a mixture is (aside from the free energy of mixing) equal to the sum of the free energies of the pure components computed at a reduced temperature and reduced volume characteristic of the environment of the molecules in the solution. This proposal is tested for a simple model, the generalized cell model for solutions, and found to be a good approximation. A.

532.77

1891. THEORY OF PROTEIN SOLUTIONS. II. T.L.Hill.
J. chem. Phys., Vol. 23, No. 12, 2270-4 (Dec., 1955).

The formal theory of Pt I, (Abstr. 5260/1955) is extended to include the binding of several different species of ions or molecules on a protein, aggregation in a protein solution, and solutions containing more than one type of protein molecule. A.

532.77 : 535.343

1892. INFRARED STUDIES ON THE SOLVENT-SOLUTE INTERACTIONS. T.Yoshino.
J. chem. Phys., Vol. 24, No. 1, 76-9 (Jan., 1956).

The solvent effects on the infrared absorption bands of trans-1, 4-dichlorocylohexane in the binary solvent cyclohexane-dioxane were measured. The frequency shifts of band centres are nearly proportional to the mixing ratio of the solvent, while the band widths reach the maxima at the intermediate values of the mixing ratio. These changes of solvent effects agree with the results of computations based on the assumption of the binomial distribution of solvent molecules around the solute molecules. The existence of the maximum of band width is well explained as due to an entropy factor, that is, to the various arrangements of solvent molecules encircling the solute molecules. A.

MECHANICS OF GASES 533

533.15 : 534.222.2

1893. THE PASSAGE OF A PLANE SHOCK WAVE THROUGH A WIRE GAUZE. J.E.Bowman and G.B.F.Niblett.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1008-16 (Dec., 1955).

A shock tube has been used to investigate the attenuation of a plane shock wave when is passes through a wire gauze, the plane of which is parallel to the shock front. A gauze having a solidity ratio of about 50% reduced the over-pressure behind a shock of strength 1.65 moving into air at atmospheric pressure from 9.4 lb.in^{-2} to 7.9 lb.in^{-2}. This result is compared with avaliable data for the steady flow of air through screens. A.

533.15 : 539.155.2

1894. PERFORMANCE OF A HOT-WIRE THERMAL DIFFUSION COLUMN. J.W.Corbett and W.W.Watson.
Phys. Rev., Vol. 101, No. 2, 519-22 (Jan. 15, 1956).

The performance of a carefully constructed, metal, hot-wire, thermal diffusion column is examined in the regions of laminar and turbulent gas flow in the column for several hot-wire temperatures using the normal argon isotopic mixture as a column gas. A new experimental method is employed which simplifies and increases the accuracy of the experiment

At the lowest temperature examined, quantitative agreement with theory is observed without the use of a parasitic remixing factor. The effect of spacers on the centre wire on column performance was also examined. No significant effect was observed, this being attributed to the careful construction of the column. A.

533.5 : 531.788

1895. EXPERIMENTAL DETERMINATION OF THE PENNING-GAUGE CHARACTERISTICS. M.Varićak, B.Vošicki and B.Saftić.
Period. math.-phys. astron. (Zagreb), Vol. 10, No. 1-2, 89-96 (1955).

The optimum working conditions are investigated. Oscillograms of the discharge current J as a function of the anode voltage V for constant magnetic field strength H, and of J as a function of H for constant V, were observed for different pressures. The gauge system, which is shown diagrammatically, was constructed so as to permit quick change of electrodes and results obtained using various electrode materials are tabulated. A stable gauge consisting of a 2.5 cm dia. Mo anode ring and stainless steel cathode plates, 1.5 cm dia. and 2.5 cm apart, was constructed and its pressure calibration curve for the optimum operating conditions of 1200 volts and 400 gauss is given. S.Weintroub

533.6.011.1

1896. A STUDY OF THE COMPRESSIBLE FLOW PAST A CHERRY PROFILE. H.Takami.
J. Phys. Soc. Japan, Vol. 11, No. 2, 145-54 (Feb., 1956).

The flow is studied by means of Kármán-Tsien's method, the M^2-expansion method and Meksyn-Imai's method. The velocity distributions over the surface of the profile are calculated for various free stream Mach numbers and compared with Cherry's exact one as well as with one another. Imai's $\Phi\Psi$ procedure in the M^2 expansion method is shown to be the most efficient for the study of the flow up to comparatively high (subsonic) Mach number. It is found that there exists a qualitative difference between the velocity distribution of Cherry's exact solution and those calculated by means of approximate methods, and there is some discussion of Cherry's solution. A.

533.6.011.3

1897. PRESSURE FIELD WITHIN HOMOGENEOUS ANISOTROPIC TURBULENCE. R.H.Kraichnan.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 64-72 (Jan., 1956).

Integral expressions are derived for the mean-square fluctuation pressure, pressure correlation, and certain moments of the pressure correlation within general anisotropic, homogeneous turbulence. Application is made to idealized flow models exhibiting certain anisotropy characteristics similar to those observed in boundary-layer turbulence. Pressure fluctuations arising from the turbulence itself and from interaction of the turbulence with a mean flow exhibiting constant shear are compared with the isotropic case. It is found that, in contrast to the completely isotropic case, the anisotropic pressure correlation is negative for some difference coordinate values and exhibits a "tail" which falls off with distance x as x^{-3} at separations for which the velocity correlations have fallen essentially to zero. It is concluded that in general the principal normalized moments of the pressure correlation will tend to be less than the corresponding velocity correlation moments. For isotropic turbulence this implies that the pressure correlation must fall off with distance faster than the velocity correlation. For the models of anisotropic turbulence treated it is found that departure from isotropy results in lower mean-square pressure fluctuations for a given mean kinetic energy of turbulence. A.

533.6.011.5

1898. SUPERSONIC JET WITH THE AMBIENT PRESSURE CORRESPONDING TO ITS CONSTANT PRESSURE POINT. H.Oguchi.
J. Phys. Soc. Japan, Vol. 11, No. 2, 155-9 (Feb., 1956).

A plane jet issuing from a parallel supersonic nozzle into the chamber, where the pressure corresponds to the constant pressure point on the shock polar related to the uniform velocity at the exit nozzle, is investigated by the hodograph method under the transonic approximation. The analytical expression for the stream function ψ is obtained in the form containing appropriate constants which are determined from the condition on the shock polar. Actually, ψ is calculated so that the shock condition is satisfied at three points on the shock polar. Using this value of ψ, the shock pattern and the velocity distribution along the axis of the jet are obtained. It is seen from these results that large variations of the flow variables occur in a comparatively narrow region downstream of the exit of the nozzle. A.

MOLECULAR THEORY OF GASES 533.7

533.7

1899. THERMAL INVESTIGATION OF THE MOLECULAR FLOW OF RAREFIED AIR. F.M.Devienne.
Publ. sci. tech. Minist. Air (France) No. N.T. 55, 30 pp. (1955). In French.

Air of 2 - 7 x 10^{-4} mm pressure is flowing at near-sonic or subsonic speed against a baffle consisting of a minute plate of aluminium. In consequence the temperature of the baffle is slightly elevated and the resulting excess temperature (0.03-0.5 deg C) is measured by means of a thermo-couple. It appears that the kinetic theory of gases cannot give a quantitative account of the experimental results if the usual approximations are made. Agreement could be established by assuming that the accommodation coefficient decreases if the speed is increased. R.Eisenschitz

533.7

1900. SOLUTION OF THE BOLTZMANN–HILBERT INTEGRAL EQUATION. C.L.Pekeris.
Proc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 9, 661-9 (Sept., 1955).

The author studies Hilbert's form of the Boltzmann equation for the velocity distribution function of a model gas of rigid spheres. Expansion of the kernel of the integral equation into spherical harmonics makes it possible to reduce the Boltzmann equation, for the case of viscosity, heat conduction and self-diffusion of a simple gas, to an integral equation in one dimension and thence to an ordinary differential equation. For the case of self-diffusion this equation is of the second order, and numerical integration leads to a value of the coefficient of self-diffusion which agrees exactly with the value obtained by the Chapman–Enskog method. The work is compared with Pidduck's treatment (1916) of the same problem and it is pointed out that Boltzmann himself had derived by very laborious methods, but had failed to integrate, the second-order differential equation for the case of self-diffusion and the corresponding (fourth-order) equation for the viscosity problem. E.H.Sondheimer

533.7

1901. VIRIAL EXPANSION FOR MIXTURES OF RIGID SPHERES. A.G.McLellan and B.J.Alder.
J. chem. Phys., Vol. 24, No. 1, 115-21 (Jan., 1956).

The equation of state for a binary mixture of rigid spheres of arbitrary size ratio is developed up to the fourth virial coefficient. The superposition approximation is employed and thus the fourth virial coefficient is inexact, however the second and third are evaluated precisely. The important thermodynamic functions are tabulated as well as the changes in these functions upon mixing at constant free volume. The fourth virial coefficient is evaluated exactly for the case where one of

the components is a point sphere and the result is compared with the approximate one. A.

533.7

1902. KINETIC THEORY OF NONSPHERICAL MOLECULES. C.F.Curtiss.
J. chem. Phys., Vol. 24, No. 2, 225-41 (Feb., 1956).

A modification of the Boltzmann equation is described in which the rotational motion of nonspherical molecules is considered classically. This Boltzmann equation leads to equations of continuity, motion, and energy balance similar to the equations applying when the molecules are spherical. An additional equation of change arises, however, because of the conservation of angular momentum in collisions. (When the molecules are spherical, this equation is redundant). Associated with the additional equation of change, there appears an additional "macroscopic variable" related to the local density of angular momentum due to the rotational motion of the molecules and an additional flux vector representing the flux or transport of this angular momentum. The Boltzmann equation is solved by a perturbation method similar to the Chapman–Enskog first approximation, and expressions are obtained for the various flux vectors and transport coefficients. Although the equations of change apply under more general conditions, the present treatment is restricted to molecules which may be idealized as rigid nonspherical bodies in which the centre of mass is a centre of symmetry. A.

533.7 : 536.71

1903. ASSOCIATION AND THE EQUATION OF STATE. R.Ginell.
J. chem. Phys., Vol. 23, No. 12, 2395-9 (Dec., 1955).

A form of the generalized gas law considering explicitly association into all possible species is derived. This law has the additional variables β_i, b, and ΣN_x. When β_i which is a function of the ratio of the surface of the container to the volume is neglected, as it can be at larger volumes, then the equation can be solved. Using the results derived from association theory, this gas law is developed into the form of the virial equation. The virial coefficients are functions of the equilibrium constants of association and the excluded volumes. A method of solution is indicated whereby the equilibrium constants and the excluded volumes of the individual j-mers can be obtained serially. A.

VIBRATIONS. ACOUSTICS 534

534.131

1904. RADIAL VIBRATIONS IN SHORT, HOLLOW CYLINDERS OF BARIUM TITANATE. C.V.Stephenson.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 51-6 (Jan., 1956).

The theory of radial vibrations in short, hollow cylinders of barium titanate has been developed. This development results in an expression which relates the radial coupling coefficient to the measurement of the resonant and antiresonant frequencies of the first harmonic of the radial mode of vibration. The important parameter in this development was found to be the ratio of outside diameter to inside diameter, and once this ratio was given, the expression relating coupling coefficient to resonance measurement took a particularly simple form. An interesting result of theory was that for any value of the ratio of diameters, many of the higher harmonics are forbidden in this mode of vibration. Experiments were devised to test some of the theoretical conclusions and were found to be in excellent agreement with the theory. A.

534.141 : 532.623

1905. GAS BUBBLES AS SOURCES OF SOUND IN LIQUIDS. M.Strasberg.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 20-6 (Jan., 1956).

Gas bubbles, when entrained in water or other liquid, can generate high sound pressures in the liquid. Significant sound pressures are associated only with volume pulsations of the bubble, whereas oscillations in the shape of the bubble do not result in appreciable sound. Calculations have been made of the sound pressures resulting from excitation of volume pulsations by the following mechanisms: by bubble formation, coalescence, or division; by the motion of a free stream of liquid containing entrained bubbles past an obstacle; and by the flow of liquid containing entrained bubbles through a pipe past a constriction. The calculation of the sound pressure generated by bubble formation has been verified by measurements with bubbles formed at a nozzle. A.

534.142.1

1906. ON THE THEORY OF THE GOLD-LEAF THERMOPHONE. P.Riéty.
Ann. Télécomm., Vol. 10, No. 7-8, 168-178 (July-Aug., 1955). In French.

In the introduction the author outlines a brief history of the development of the thermophone and describes the method of mounting the gold leaves in the S.F.E.R.T. model. The gold leaf has dimensions 2.54 x 1 cm x 0.1 micron approximately. The leaves in series are traversed by a variable current which heats them periodically by the Joule effect. These heat variations produce corresponding variations of temperature, and consequently of pressure, in the surrounding gas. These changes of pressure result of course in sound emission. It is this pressure which is determined by the author's theory. The theory considers first of all the stationary state of the system and then the state in the periodic regime. It evaluates the temperature near the gold leaves, whence is determined the acoustic pressure in the surrounding air-space. See also abstract following. A.B.Wood

534.142.1

1907. ON THE THEORY OF THE GOLD-LEAF THERMOPHONE. P.Riéty.
Ann. Télécomm., Vol. 10, No. 9, 195-201 (Sept., 1955). In French.

The paper reported in the preceding abstract surveyed the historical development of the gold-leaf thermophone. The present paper gives a more complete theoretical treatment. Comparison is made with the theories of Wente, Ballantine and Geffcken. A series of comparative sensitivity–frequency curves shows that the author's theoretical curve falls between those of the others at the lower end of the frequency scale, but indicates a somewhat lower sensitivity at the higher frequencies. A.B.Wood

534.154

1908. FORCED VIBRATION WITH DAMPING. D.A.Richards.
Amer. J. Phys., Vol. 23, No. 9, 557-61 (Dec., 1955).

The experimental determination of the response curves for forced vibration with velocity damping, using a moving-coil galvanometer, is described. The mechanism for producing a sinusoidal e.m.f. of continuously variable frequency ranging from zero to 0.4 c/s, is described, together with a method for the determination of the phase angle between the driving force and the motion of the driven system. Experimental results, obtained with the apparatus, both for response curves and phase angle measurements, for various values of damping, are summarized in the paper. A.

534.171

1909. ACOUSTIC DOPPLER EFFECT AND PHASE INVARIANCE. A.H.Spees.
Amer. J. Phys., Vol. 24, No. 1, 7-10 (Jan., 1956).

Attention is called to the usefulness of the Doppler effect in introducing the idea of invariance with respect to coordinate transformation. The invariant property of the phase of a sound wave with respect to Galilean transformation is applied

to several Doppler effects including that resulting from transverse motion of source and detector in a moving medium. A.

534.21

1910. ON THE PROPAGATION OF SOUND WAVES IN A VISCOUS GAS IN THE PRESENCE OF HEAT CONDUCTION. A.A.Kasper'yanc.
Prikl. Mat. Meh., Vol. 18, 729-34 (1954). In Russian.
Translation available from M.D.Friedman, 2 Pine Street, West Concord, Mass., U.S.A.

General solutions are obtained of linearized equations for viscous, thermally conducting perfect gases, assuming the velocity, condensation, etc. are proportional to $e^{i\sigma t}$, where σ is a constant. Mathematical Reviews

534.213

1911. PROPAGATION OF SOUND PULSES IN A DISPERSIVE MEDIUM. J.M.Proud, P.Tamarkin and E.T.Kornhauser.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 80-5 (Jan., 1956).

The dispersion of a rectangular pulse with many cycles of carrier frequency propagated along an acoustic waveguide of rectangular cross-section has been observed experimentally. The main signal is propagated with the group velocity and is observed to separate from the initial and final transient portions which travel with the greater, free medium velocity. In the dispersion process, the beating of the initial transient with the main signal causes fluctuations in the envelope of the carrier which compare favourably with the mathematical formulation given. This experiment serves, essentially, as a calibration of the waveguide so that it can be used qualitatively as a type of analogue computer to predict the effects of similar dispersion on the transmission of pulses of other shapes that are not amenable to actual computation. A.

534.213.4

1912. PROPAGATION OF ELASTIC WAVES IN CYLINDRICAL SHELLS, INCLUDING THE EFFECTS OF TRANSVERSE SHEAR AND ROTATORY INERTIA. P.M.Naghdi and R.M.Cooper.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 56-63 (Jan., 1956).

Two systems of equations of motion, designated as (I) and (II), for thin elastic cylindrical shells are derived which include the effects of both transverse shear deformation and rotatory inertia. The character of the two systems of equations is such that, upon the neglect of transverse shear deformation and rotatory inertia, Eqs. (I) will reduce to those known as Love's first approximation, while (II), which enjoys a considerable mathematical simplicity as compared to (I), will correspond to those given by Donnell. Both systems of Eqs. (I) and (II) are employed in a study for propagation of axisymmetric waves in an infinite cylindrical shell. The agreement between the predictions of the two systems of equations, in all modes of motion, for phase velocities of propagated waves in the complete range of wavelengths is found to be excellent. The results, with reference to the nature of the modes of motion according to both (I) and (II), are further examined and the relative merit of the present paper to the work of other authors is discussed. A.

534.22/.23

1913. TABULAR DATA OF THE VELOCITY AND ABSORPTION OF HIGH-FREQUENCY SOUND IN MAMMALIAN TISSUES. D.E.Goldman and T.F.Hueter.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 35-7 (Jan., 1956).

This report is a condensed presentation of currently available data. A.

534.22/.23

1914. ULTRASONIC RELAXATION IN NORMAL PROPYL ALCOHOL. T.Lyon and T.A.Litovitz.
J. appl. Phys., Vol. 27, No. 2, 179-87 (Feb., 1956).

This has been investigated using pulse techniques. Measurements of velocity and absorption were made at frequencies from 1 to 82 Mc/s and over a temperature range 0 to -155°C. The data could be explained by assuming a distribution of relaxation times, and it is suggested that the distribution of relaxation times is but a reflection of the distribution of activation energies for the elementary molecular processes involved. A theory based on the assumption of a uniform distribution of activation energies for compressional processes and a single relaxation time for the shear process is presented. The agreement between the values calculated from this theory and the experimental data is good except at very high viscosities. The compressional viscosity calculated from the theory was found to be nearly equal to the shear viscosity except at very high viscosities. This is in agreement with the compressional viscosity calculated from the "excess" absorption in the nondispersion region. A.

534.22

1915. PROOF OF THE EXPRESSION $(E/\rho)^{\frac{1}{2}}$ FOR THE VELOCITY OF SOUND BY USE OF AN EQUALITY OF ENERGIES. W.W.Sleator.
Amer. J. Phys., Vol. 24, No. 1, 15-18 (Jan., 1956).

An argument is presented by which the velocity equation for sound waves in a gas is obtained as a result of equating the kinetic and potential energies per unit volume at the same time and position in the wave train. A.

534.22 : 541.64

1916. ULTRASONIC MEASUREMENTS ON HIGH POLYMERS. P.Hatfield.
J. appl. Phys., Vol. 27, No. 2, 192-3 (Feb., 1956).

The velocity and absorption of longitudinal waves in high polymers was measured over the temperature range -10 to 60° C and over the frequency range 50 to 1000 kc/s, using a continuous-wave method. Velocity dispersion of 8% occurred with Hycar O.R. 15 in the range 30-50° C and 350-940 kc/s. A similar degree of dispersion occurred within this frequency range with polyvinyl chloride and butyl rubber. The method was not sufficiently accurate to show the small dispersion expected with polyethylene and Nylon 6.6. Absorption peaks occurred in polyethylene, polyvinyl chloride, Hycar O.R. 15, butyl and natural rubber, but not in 6, 6.6, and 6.10 polyamides. Increase of frequency raised the temperature at which the absorption peaks occurred with butyl rubber, natural rubber, Hycar and polyvinyl chloride. The amplitude of the absorption peaks showed an approximate linear increase with frequency. A.C.Whiffin

534.22 : 551.46

1917. ACOUSTIC AND OTHER PHYSICAL PROPERTIES OF SHALLOW-WATER SEDIMENTS OFF SAN DIEGO. E.L.Hamilton, G.Shumway, H.W.Menard and C.J.Shipek.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 1-15 (Jan., 1956).

Reports on a continuing study of the mass physical properties of surficial, shallow-water marine sediments off San Diego, California. Sound velocity measurements in situ at 100 kc/s were made by pulsing between small transducers inserted into the bottom by diver. Density, porosity, and size analyses were determined on relatively undisturbed samples taken by diver. Laboratory measurements of velocity and attenuation at 25 to 35 kc/s were made by a resonant-chamber method using diver-taken samples; average attenuation values of about 0.5 db/ft (silt) to about 5 db/ft (fine sand) were obtained. At three stations the sediment sound velocity was less than the velocity in the bottom water. A.

534.22 : 551.46

1918. LOW SOUND VELOCITIES IN HIGH-POROSITY SEDIMENTS. E.L.Hamilton.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 16-19 (Jan., 1956).

Recent in situ and laboratory determinations of density and velocity of sound in fine-grained, high-porosity sediments of the sea floor off San Diego, California (preceding abstract), reveal several stations at which the velocity of sound in the

sediment was 2% to 3% less than the velocity of sound in the water just above the bottom. Comparison of the compressibility of the sediment computed in two ways and of the ratio: velocity in sediment/velocity in water computed and actually measured indicates that these high-porosity sediments are approximately described acoustically by the velocity formula which applies to a suspension. The theoretical explanation for this phenomenon was apparently made by R.J.Urick (Abstr. 1091, 2406/1948, 3048/1949). A.

534.23

1919. ATTENUATION OF 5 MC. SOUND IN ALUMINUM AT LOW TEMPERATURES. T.S.Hutchison and A.J.Filmer.
Canad. J. Phys., Vol. 34, No. 2, 159-65 (Feb., 1956).

The attenuation of sound at a frequency of 5 Mc/s has been found to reach a maximum in aluminum at 155°K. Combination of this result with the work of Bordoni, who obtained a maximum at 40 kc/s and 100°K, gives a value for the activation energy which is in agreement with that calculated by Mason for a dislocation relaxation process. The maximum is greatly increased by plastic deformation. The velocities of sound for annealed and cold-worked aluminum show a maximum difference about 155°K, again indicating a dislocation mechanism. The maxima are superimposed on a background attenuation mostly caused by scatter at grain boundaries and diffraction. A.

534.231

1920. INVESTIGATION OF SCALAR WAVE FIELDS BY MEANS OF INSTANTANEOUS DIRECTIVITY PATTERNS. J.Pachner.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 90-2 (Jan., 1956).

A method is proposed for determining the travelling and standing components of an arbitrary scalar wave field from the measured instantaneous values of the field on the surface of two spheres surrounding the emitter. A.

534.231 : 778.3

1921. NEW METHODS OF VISUAL DISPLAY OF ULTRASONICS. F.Hauer and G.Keck.
Naturwissenschaften, Vol. 42, No. 22, 601-2 (1955). In German.

A discussion of the action of ultrasonic fields in liquids on gelatine films and photographic plates used for visual display of the field. T.C.Toye

534.231.3

1922. MECHANICAL IMPEDANCE MEASUREMENTS OF SOILS. W.R.Runyan and R.E.Anderson.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 73-6 (Jan., 1956).

A method of measuring the mechanical impedance of the earth is described, and some experimentally measured impedances as functions of water content, soil character, and source diameter are given. A comparison of the measured impedance with some previous theoretical work is also included. A.

534.232

1923. ON THE PRODUCTION OF SOUND IMPULSES BY MEANS OF LOUDSPEAKERS, FOR MEASUREMENTS IN ROOM ACOUSTICS. H.Niese.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 3, 84-90 (Nov., 1955). In German.

A sound transmitter is described which emits controlled short-time sound impulses. This impulse transmitter is designed primarily to meet requirements in room-acoustic measurements. The sound–pressure–time function of the impulses show that the observed values are in agreement with theoretical expectations. Oscillograph records are reproduced in illustration of the various types of sound impulse emitted by a loudspeaker. Directional curves of the impulse emitted show that the radiation approximates to a spherical distribution. A.B.Wood

534.232

1924. ON THE DEPENDENCE OF DIRECTIVITY PATTERNS ON THE DISTANCE FROM THE EMITTER. J.Pachner.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 86-90 (Jan., 1956).

A method is developed for easily determining the directivity pattern in an arbitrary distance from the emitter from measured instantaneous values of the field in other distance from the emitter from measured instantaneous values of the field in other distance. Numerical computation is facilitated by the tables put together in this paper. A.

534.232

1925. LINE SOURCE WITH PROGRESSIVE PHASE SHIFT. R.E.Burgess.
Canad. J. Phys., Vol. 34, No. 1, 149-50 (Jan., 1956).

The integral representation obtained by Thiessen (Abstr. 153/1956) in evaluating the energy radiation from an acoustic line source with progressive phase shift can be expressed in a form containing tabulated functions. This simplifies calculations and enables asymptotic approximations to be made readily when $R = 1/\lambda$ is large. Some discrepancies in Thiessen's curves near $\sigma = 2$ are noted. H.J.H.Starks

534.24

1926. UNDERWATER SOUND REFLECTION FROM A CORRUGATED SURFACE. E.O.LaCasce, Jr and P.Tamarkin.
J. appl. Phys., Vol. 27, No. 2, 138-48 (Feb., 1956).

Theories of rough surface reflection by Rayleigh, Eckart and Brekhovskikh are utilized to calculate the dependence, on surface and radiation parameters, of the amplitudes of reflected radiation when an acoustic beam is incident on a pressure-release surface with sinusoidal corrugations. The results of these theories are compared, with emphasis on the assumptions used. Experimental results for the reflection of an underwater acoustic beam from this type of surface are presented and compared with each of the theories. The best agreement between theory and experiment is obtained for surfaces of small slope, indicating that this criterion is basic to the validity of the theories. However, surprisingly similar results are obtained for surfaces of large slope. The theories seem to predict the behaviour of the lower orders of reflection more closely than that of the higher orders. Good agreement between theory and experiment is obtained for directions of reflection and for cut-off frequencies. A.

534.26

1927. MEASUREMENTS WITH A MODIFIED SCHILLING SOUND APPARATUS. R.C.Hoyt.
Amer. J. Phys., Vol. 24, No. 1, 34-7 (Jan. 1956).

A commercial electrostatic speaker is now available that provides an excellent and cheap line source of high frequency sound in the 1000 c/s to 20 000 c/s range. It can also be operated in reverse to act as a quite satisfactory detector at these frequencies. By replacing the Galton whistle with one of these speakers, and using a second speaker as a detector, the Schilling apparatus can be used for quantitative undergraduate experiments on interference and diffraction, yielding results to better than 2% accuracy. A.

534.321.9

1928. INDUSTRIAL APPLICATIONS OF ULTRASONICS. E.G.Richardson.
Brit. J. appl. Phys., Vol. 6, No. 12, 413-15 (Dec., 1955).

Techniques used recently in this field are described, in relation to echo-detecting, high-frequency agitation and metallurgical applications. The possibilities and limitations of ultrasonics for these purposes are discussed. A.

534.512.1 : 534.321.9 : 535.3

1929. INVESTIGATION OF STATIONARY ULTRASONIC WAVES BY LIGHT REFRACTION. A.P.Loeber and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 27-35 (Jan., 1956).

An optical method for the quantitative study of ultrasonic wave fields at frequencies below 1 Mc/s has been developed and applied to stationary waves. The method is based on the effect of mirage. A detailed theoretical analysis shows the possibility of determining wave forms and sound pressure amplitudes. Some experimental results of sound velocity and pressure amplitude determinations are given. The records of wave forms in several liquids indicate the distortion of waves during propagation. A.

534.612

1930. SOUND MEASUREMENTS AT VERY HIGH LEVELS. A.Peterson.
I.R.E. Trans Audio, Vol. AU-3, No. 3, 71-6 (May-June, 1955).

The behaviour of a number of microphones at high sound levels is described. Some of the problems of making measurements at these levels are discussed. A.

534.614

1931. DETERMINATION OF THE VELOCITY OF ULTRASONIC VIBRATIONS IN MOLTEN SALTS. N.E.Richards, E.J.Brauner and J.O'M.Bockris.
Brit. J. appl. Phys., Vol. 6, No. 11, 387-90 (Nov., 1955).

An apparatus for the direct measurement of the velocity of sound in molten liquids at temperatures up to 1000° C is described. The technique depends upon the phase interference of two wave trains, one passing through the liquid and the other a reference signal. The apparatus gives results to within 0.5% of accepted values. The theory of the method is investigated. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

1932. AUTOMATIC EXTRACTION OF FORMANT FREQUENCIES FROM CONTINUOUS SPEECH. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 110-18 (Jan., 1956).

Two electronic devices for automatically extracting the first three formant frequencies from continuous speed are described. Both devices are designed to yield three continuous d.c. output voltages whose magnitudes, as functions of time, represent the formant frequencies of the input speech. The principles of operation and the design features of both devices are discussed, and typical examples of the operation of each are presented. A.

534.78

1933. EVALUATION OF TWO FORMANT-EXTRACTING DEVICES. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 118 (Jan., 1956).

A procedure for evaluating the operation of two electronic formant extractors is described and results of the evaluation are given. The formant extractors are designed to yield electrical outputs representing the formant frequencies of continuous input speech. These outputs are compared in a prescribed manner to formant data derived from sound spectrograms. The results show that the more reliable extractor of the two follows the first formant of vowel sounds in speech within ± 200 c/s greater than 91% of the time. The first and second formant outputs of the same extractor are simultaneously within the above tolerances greater than 85% of the time. A.

534.83

1934. PROPAGATION OF CORRELATION FUNCTIONS IN CONTINUOUS MEDIA. R.H.Lyon.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 76-9 (Jan., 1956).

The correlation properties of noise fields when considered as a random superposition of elementary sources are derived as an extension of Rice's work on the shot effect (Bell System Tech. J. Vol. 34, 282, 1944; Vol. 24, 46, 1945). Next a formalism is derived which calculates the correlation properties of the response of a continuous, linear system when subject to an applied noise field. The requirements for solution are a knowledge of the impulse response of the system and the correlation function of the source. The latter may be obtained experimentally or from calculation. A.

534.839

1935. NOISE ANALYSIS WITH A HETERODYNE-TYPE SONIC ANALYZER. J.D.Richard, Jr, P.F.Smith and F.H.Stephens.
I.R.E. Trans Audio, Vol. AU-3, No. 2, 37-42 (March-April, 1955).

The analysis of a specific noise recording is shown as an example. A method is also described for obtaining spectrum levels directly from the cathode-ray tube photographs. A.

534.844.2

1936. CONTRIBUTION TO THE STATISTICAL TREATMENT OF REVERBERATION PHENOMENA. W.Kraak.
Hochfrequenztech. u. ElektAkust., Vol. 64, No. 3, 90-3 (Nov., 1955). In German.

A critical discussion based on statistical principles of the reverberation-time formula of C.F.Eyring (J.Acoust. Soc. Amer., Vol. 1, 217, Jan., 1930), H.and L.Cremer (Akustische Zeitschrift, Vol. 2, 225, 1937) and of K.Schuster (Ibid, Vol. 4, 313,1939). The discussion centres mainly on the distribution of the absorption material on the bounding surfaces of the room. A.B.Wood

534.844.5

1937. ON THE INFLUENCE OF VIBRATORY SOUND ABSORBERS ON THE REVERBERATION TIME OF ROOMS. D.Brodhun.
Nachrichtentechnik, Vol. 5, No. 8, 354-60 (Aug., 1955). In German.

Consideration is given to the use of (1) Helmholtz resonators, (2) perforated panels (3) 'plate' resonators and (4) tube-resonators, in the walls and ceilings of rooms to produce optimum reverberation conditions. After referring to earlier work on the subject the author describes experiments in a model room, using these types of resonators. Numerous curves are given to show the relation between reverberation time, frequency, acoustic resistance etc. A.B.Wood

534.845

1938. PLATE RESONATORS AS ACOUSTIC LOW FREQUENCY ABSORBERS. A.Lauber.
Tech. Mitt. PTT, Vol. 33, No. 5, 192-7 (1955). In German.

The new studios of radio diffusion of the "Deutschen Südwestfunks" are fitted with plate resonators of a special kind as a means of obtaining a good absorption of low frequency sounds. The author describes a series of measurements of this type of resonant absorber and their application to the acoustic treatment of rooms. The absorber consists of a suitably loaded rectangular metal plate which closes a cavity in which is mounted, parallel to the metal plate, a second plate of sound-absorbent material (e.g. porous glass-wool). The resonance frequency of this resonance absorber, mounted on the wall of a room is calculated from a formula given by G.Kurtze (Abstr. 814/1955). A.B.Wood

534.845

1939. ABSORPTION CHARACTERISTICS OF UPHOLSTERED THEATER CHAIRS AND CARPET AS MEASURED IN TWO AUDITORIUMS. R.N.Lane.
J. Acoust. Soc. Amer., Vol. 28, No. 1, 101-5 (Jan., 1956).

Data on the absorption of upholstered theatre chairs as measured during the construction of a 496 seat auditorium and a 738 seat auditorium are presented. These data obtained on the seats after placement in each auditorium indicate a much

lower absorption per seat over the entire audio-frequency band than has previously been reported. Before the seats were installed in the 496 seat auditorium, 1080 ft^2 of Axminster carpet were laid on the floor of this room, and the absorption characteristics of this full-scale sample were determined. These data are also reported in this paper. A.

534.862.6

1940. PERCEPTIBILITY OF FLUTTER IN SPEECH AND MUSIC. F.A.Comerci.
I.R.E. Trans Audio, Vol. AU-3, No. 3, 62-70 (May-June, 1955).

The perceptibility of flutter at various rates, in recordings of speech and music, was investigated in relation to the development of a flutter meter which will give a direct indication of the effect upon programmes as judged by listeners. A.

OPTICS. RADIATION. SPECTRA 535

535.231.4

1941. EMISSIVITY OF HYDROGEN ATOMS AT HIGH TEMPERATURES. H.Aroeste and W.C.Benton.
J. appl. Phys., Vol. 27, No. 2, 117-21 (Feb., 1956).

A method is described for making estimates of the total emissivity of hydrogen in the temperature and pressure ranges where hydrogen atoms predominate under equilibrium conditions. For a typical geometrical depth of 50 cm, and temperatures of the order of 12 500°K and higher, with pressures of the order of 100 atm and higher, the emissivity approaches unity (above about 0.95), while for temperatures of the order of 9500°K and lower, with pressures of the order of 10 atm and lower, the emissivity approaches zero (below about 0.05). The variations of the emissivity between these approximate limits are shown graphically as functions of temperature and pressure with the geometrical depth set at 50 cm. The variation of the emissivity with geometrical depth is also shown graphically at 12 600°K and 20 atm. A.

535.242.41

1942. AN INTEGRATING PHOTOMETER EMPLOYING SCALLOPED GRATINGS. L.R.Baker.
J. sci. Instrum., Vol. 32, No. 11, 418-21 (Nov., 1955).

A new type of controlled-diffuser consisting of a scalloped grating has been developed, and this leads to the design of a high accuracy integrating photometer, which can operate when the total light flux is below one microlumen. Both the theory and the details of preparation of a scalloped grating diffuser are given. An experiment illustrating the efficiency of the scalloped grating relative to other diffusers is described together with an experimental test on a particular design of integrating photometer. A.

535.247.4

1943. INTEGRATING METERS FOR COMPARING LIGHT INTENSITIES IN PLANT GROWTH STUDIES. A.H.Allan and K.J.McCree.
J. sci. Instrum., Vol. 32, No. 11, 422-4 (Nov., 1955).

The considerations, so far as they are at present known, which control the design of a light meter for finding the relative amount of visible radiation reaching undergrowth are discussed, and two instruments designed to meet the requirements are described A.

535.247.4 : 548.733

1944. AN AUTOMATIC RECORDING MICRODENSITOMETER. W.A.Wooster.
J. sci. Instrum., Vol. 32, No. 12, 457-60 (Dec., 1955).

Describes an automatic recording microdensitometer based on the Dobson split-beam type of instrument, using a single lamp and single photocell. The shutter is driven at a non-synchronous speed and an electromechanical transducer is used to convert the output to a synchronous frequency. This output is used to operate a servomechanism which moves a straight photographic wedge and also a potentiometer. The output from the potentiometer drives a standard pen recorder. The film carriage has movements of 28.5 cm and 12.5 cm in perpendicular directions and accurate measurements of these displacements can be read on scales permanently in place. A.

535.31

1945. CONSEQUENCES OF PARAMETER-INVARIANCE IN GEOMETRICAL OPTICS. R.H.Penfield.
Amer. J. Phys., Vol. 24, No. 1, 19-22 (Jan., 1956).

In the electromagnetic theory one hears of gauge invariance and the difficulties that result from this. Similar obstacles arise in the general theory of relativity because of the coordinate covariance requirement. The actual nature of the effect of the invariance stipulations is usually not clearly understood because the theories investigated are themselves rather complicated. However, it is possible to pick a simple enough example so that one can clearly see the effect of invariance requirements. It is the purpose of this paper to pick a central problem of geometrical optics and to show what happens as a result of the parameter covariance. A.

535.317.1

1946. THE HANDLING OF OPTICAL IMAGERY BY DEVELOPMENT WITH PLANE WAVES. A.Lohmann and H.Wegener.
Z. Phys., Vol. 143, No. 4, 431-4 (1955). In German.

Instead of the usual treatment by Kirchhoff's integral, optical imagery may sometimes be more readily investigated by the use of Fourier integration of plane waves. Examples of the method with gratings and an ideal lens are given.
R.W.Fish

535.317.7 : 535.417

1947. THE MEASUREMENT OF COMATIC ABERRATIONS BY INTERFEROMETRY. J.W.Gates.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1065-72 (Dec., 1955).

The path differences from point to point between an optical wave front and its mirror image are antisymmetrical with respect to the common line about which the inversion of the mirror image has occurred. Features of the wave front which depend only on even powers of the distance from the common line disappear, while features which depend on odd powers of the distance are doubled. Thus by suitable choice of the common line the comatic errors and the distortion in the wave front may be shown up independently of the effects of change of focus, spherical aberration, astigmatism and field curvature. The analysis may be carried out on interferograms made by comparison with a known reference wave front, or by the use of the interferometer described, which compares the wave front with its own mirror image directly. This interferometer may also be used as a shearing interferometer. A.

535.321

1948. THE PROPERTIES OF SHADOWGRAPHS. H.Hannes.
Optik, Vol. 13, No. 1, 34-48 (1956). In German.

The theory of the shadowgraph used for the investigation of small changes of refractive index in optical materials is given for both divergent and parallel illuminating systems. The sensitivity, resolution and definition of such systems are calculated and photographs illustrating a variety of conditions are shown. R.W.Fish

535.321.52

1949. REFRACTIVE INDEX DETERMINATIONS BY THE CENTRAL ILLUMINATION (BECKE LINE) METHOD. R.C.Faust.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1081-94 (Dec., 1955).

These determinations depend upon the diffraction of light by the specimen. The accuracy of the method is therefore

influenced by the specimen dimensions and by the degree of defocusing of the microscope. Moreover, the method does not necessarily measure the refractive index of the surface regions of an inhomogeneous specimen. It is also shown that it is possible to observe Fresnel diffraction bands with a spacing less than the conventional resolution limit. Consequently, such band spacings do not provide a reliable estimate of the resolution limit attainable in either a light or an electron microscope. A.

535.322.1

1950. AUTOCOLLIMATING SPECTROMETER. J.W.Forrest, H.W.Straat and R.K.Dakin.
J. Opt. Soc. Amer., Vol. 46, No. 2, 143-4 (Feb., 1956).

Describes a Littrow instrument with mirror focusing and visual or photoelectric detection for measurement of refractive index (μ). Tests have been made with a quartz prism, and in the wavelength range 0.3-2.4 microns the precision is 0.0005 in μ. G.F.Lothian

535.323 : 535.345

1951. SPECTRAL INVESTIGATIONS IN THE REGION NEAR 1 mm WAVELENGTH. III. DISPERSION MEASUREMENTS ON LiF. L.Genzel and M.Klier.
Z. Phys., Vol. 144, No. 1-3, 25-30 (1956). In German.

For Pt II, see Abstr. 2561 (1955). Multiple interference measurements with thin crystals have been made of the optical constants of LiF in the region 70 to 1000 micron. The refractive index for wavelength 100 micron or over is 3.07 ± 0.03. The curve of extinction coefficient against wavelength shows secondary maxima at about 110 and 900 micron. R.F.Barrow

535.327

1952. MOLAR REFRACTION OF CARBON DIOXIDE AND ITS DEPENDENCE ON DENSITY WHEN STORED IN STEEL CONTAINERS. V.H.Coffin and C.E.Bennett.
J. chem. Phys., Vol. 24, No. 1, 98-103 (Jan., 1956).

Precise measurements of molar refraction of carbon dioxide as a function of density from zero to 0.06 g/cm^3, extend the work previously reported. Repeated runs, involving several hundred observations with the displacement interferometer, indicated an unmistakable but unaccountable negative variation of molar refraction as a function of density, until it was discovered that the age of the gas affected the results. Several hundred additional readings made on samples of gas of various ages, with and without a drying tube of magnesium perchlorate in the line, show that the molar refraction of fresh CO_2 is independent of density, as would be expected of a nonpolar substance. It is suggested that as "bone dry" CO_2 ages under pressure in steel cylinders for periods of a year or more, small amounts of CO are formed by chemical reaction. Supporting evidence for this view has been obtained by measuring the decrease in mass of a carefully weighed sample of CuO in a glass tube, as a measured volume of the CO_2 gas was passed through it at a temperature of 250° C. Because CO is strongly polar, traces of it would account for a variation of molar refraction with density such as has been observed in increasing proportions for samples of CO_2 ranging in age from one to several years. A.

535.33.03

1953. AN ULTRAVIOLET CONTINUUM IN THE SPECTRUM OF CARBON. J.G.Phillips and L.Brewer.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 341-51 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). The emission spectrum of C has been studied with a photoelectric spectrum-scanner, using a carbon-resistance electric furnance as source. At temperatures of 2700°K or greater a strong u.v. continuum appears, the intensity of which increases rapidly with temperature. At 2900°K, the integrated intensity in the band 3700 A to 4800 A, equals that of all the Swan bands of C_2. This continuum may be present (in absorption) in the spectra of late N-type stars. D.R.Barber

535.33.03 : 545.828

1954. AN ATOMIZER-BURNER COMBINATION FOR FLAME SPECTROMETRY. R.Herrmann and H.Schellhorn.
Z. angew. Phys., Vol. 7, No. 12, 572-5 (Dec., 1955). In German.

A new apparatus and its operation are described. It consists of a hydrogen burner using oxygen under pressure, and incorporating an atomizer into which the liquid for analysis is introduced by a motor-driven syringe. An advantage of the apparatus is the lower background produced in spectrograms. S.T.Henderson

535.33.07

1955. SLIT DRIVES FOR SINGLE-BEAM, INFRA-RED SPECTROMETERS. E.L.Blount and A.R.H.Cole.
J. sci. Instrum., Vol. 32, No. 12, 471-3 (Dec., 1955).

The use of automatic slit drives on single-beam spectrometers is considered and a simple method of making a string slit drive for a calcium fluoride prism is described. The method is applicable to any prism for which the rate of increase of slit opening is not too rapid. A.

535.33.07

1956. A CONSTANT TEMPERATURE SOLUBILITY CELL OR REACTION VESSEL FOR A BECKMAN QUARTZ SPECTROPHOTOMETER. D.N.Glew and R.E.Robertson.
J. sci. Instrum., Vol. 33, No. 1, 27-9 (Jan., 1956).

An adapter is described which permits the use of the Beckman DU spectrophotometer for the continuous study of equilibria and reaction kinetics in solution. The design permits the optical density measurement at closely controlled temperatures, while retaining simplicity of assembly and operation. A.

535.33.07

1957. SPECIAL CUVETTES FOR SPECTROPHOTOMETRIC MEASUREMENTS OF MICRO-ORGANISMS AND LIVING TISSUES. C.W.McKeehan and I.C.Graham.
J. Opt. Soc. Amer., Vol. 46, No. 2, 141 (Feb., 1956).

Two types of cuvette are described, which allow the changing of the biological conditions during the measurement without removing the sample from the cuvette. Sealed-in hypodermic tubes allow the sample to be inserted, chemicals to be added or gases to be passed through. Electrodes for electrical stimulation are also present. R.W.Fish

535.33.07

1958. USING THE SNOOPERSCOPE WITH THE SPECTROMETER. D.E.Dean.
Amer. J. Phys., Vol. 24, No. 2, 66-7 (Feb., 1956).

The adaptation of the photoelectric image converter to the spectrometer is described. The student may observe the near ultraviolet and infrared spectrum as an extension of the visible. The visible lines still show in their colours. Some of the better sources for spectral demonstrations are recommended. The "snooperscope spectrometer" is effective in demonstrating the shrinkage of the continuous spectrum with decrease in temperature of the source. A.

535.33.07 : 535.375.5

1959. THE USE OF A COMBINATION OF AN INTERFEROMETER AND PRISM SPECTROMETER FOR THE RECORDING OF THE RAMAN VIBRATION SPECTRUM OF $GeCl_4$. R.Dupeyrat.
C.R. Acad. Sci., (Paris), Vol. 241, No. 15, 932-5 (Oct. 10, 1955). In French.

The combination is shown to be advantageous under certain conditions. The adjustment of the two systems is studied and sample results given. R.W.Fish

535.33.07 : 545.822

1960. INVESTIGATIONS ON PHOTOELECTRIC METHODS OF MEASURING LINE INTENSITIES IN EMISSION SPECTRUM

ANALYSIS. H.Krempl, D.Dorsch and H.Pfundt.
Z. angew. Phys., Vol. 8, No. 1, 16-20 (1956). In German.

Gives details of experimental methods, involving secondary emission photomultiplier tubes, for the quantitative measurement of spectral line intensities and spectrochemical analysis. Topics discussed include the spectral response of photomultipliers, analytical sensitivities (i.e. concentration — line-intensity-ratio relations) for various Fe, Si, Mn, Mg, Cu, Ti, Zn and Sn lines, generally against Al lines, and reproducibility of results etc. J.D.Craggs

535.33.07 : 771.534.53

1961. AN EXTENSION OF NOAR'S METHOD OF CALIBRATING PLATES FOR SPECTROPHOTOMETRY.
A.H.Gabriel and D.W.O.Heddle.
J. sci. Instrum., Vol. 32, No. 12, 474-6 (Dec., 1955).

A method of heterochromatic interpolation of emulsion calibration data is described. The method makes use of the co-ordinates of the calibration cross-over points on the Noar nomogram (Abstr. 2585/1952). The physical significance of these co-ordinates is discussed in an appendix. A.

535.331/.332 : 539.152.2

NUCLEAR PROPERTIES OBTAINED FROM HIGH RESOLUTION ATOMIC SPECTROSCOPY. See Abstr. 1040.

535.331

1962. ISOTOPE SHIFT AND WAVELENGTHS OF THE CURIUM SPECTRUM. J.G.Conway and R.D.McLaughlin.
J. Opt. Soc. Amer., Vol. 46, No. 2, 91-3 (Feb., 1956).

Isotope shift measurements were made on Cm^{242} and Cm^{244}. Both samples had an isotopic purity of better than 90%. Measurements were made in the spectral region between 3050 and 5250 A. One hundred and eighty-three lines of curium were recorded, one hundred and forty-eight of which showed isotope shift. Both positive and negative shifts were found. The magnitude of the shift ranged up to 1.31 K. A.

535.331

1963. ON THE LEVELS OF THE p^2-CONFIGURATION IN THE ARC SPECTRA OF Zn, Cd AND Hg. W.R.S.Garton and A.Rajaratnam.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1107-12 (Dec., 1955).

The $p^2\ ^3P_2$ level in the arc spectra of Zn, Cd and Hg has long been considered missing; the accepted explanation has been that transitions involving the level are excessively weakened by auto-ionization. By observation of the arc spectra of these elements in the range 1700-2350 A, the level in question has been located in Zn and Cd and possibly in Hg. With increasing atomic number auto-ionization increases very greatly so that one of two diffuse lines in CdI has previously been considered a band of Cd_2. Intensity measurements on this line indicate a natural-broadening profile, and yield a value for the auto-ionization probability. Previous placing of the $p^2\ ^3P_0$ level of Hg I is considered erroneous, and a new position suggested. A.

535.332/.333

1964. INTERPRETATION OF SPECTRA OF ATOMS AND MOLECULES IN SOLID NITROGEN CONDENSED AT 4.2°K.
C.M.Herzfeld and H.P.Broida.
Phys. Rev., Vol. 101, No. 2, 606-11 (Jan. 15, 1956).

The emission spectra observed from solids condensed at 4.2°K from an electric discharge through nitrogen are explained by assuming that large numbers of nitrogen atoms are deposited in the process. Approximate calculations of the interactions of the atoms with the surrounding solid show that the observed shifts, splittings, and changes of half-life of some atomic lines have the proper direction and magnitude. Analysis of a new band system provides evidence for the formation of nitrogen molecules from atoms in the solid and provides information about a new electronic state of N_2 which may be the $^5\Sigma_g^+$ state. On this basis a lower limit of 9.632 eV can be given to the heat of dissociation of nitrogen. A.

535.332

1965. EMISSION SPECTROSCOPY AT VERY LOW TEMPERATURES (COOLING BY LIQUID HELIUM II).
J.Brochard, R.Chabbal, H.Chantrel and P.Jacquinot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 935-7 (Oct. 10, 1955). In French.

The fine and hyperfine structures of the He II doublet at 4713 A have been studied with the aid of a hollow cathode cooled with liquid He under a pressure lower than that of its lambda point; with a current of 30 microamp the total width of the doublet is 24.5 mK and corresponds to the width of a Doppler line at 6°K. R.C.Murray

535.333

1966. THE SPECTRUM OF CN IN THE VACUUM ULTRAVIOLET. P.K.Carroll.
Canad. J. Phys., Vol. 34, No. 1, 83-95 (Jan., 1956).

The spectrum of the CN radical was investigated in the Schumann region using a 3 metre vacuum spectrograph in the fourth order. A hollow cathode discharge through streaming helium, to which a trace of cyanogen was added, was used as source. Three new systems of bands were found in the region 1650-2100 A. These involve two hitherto unknown states: a $^2\Sigma$ state designated by E, which gives rise to the transitions $E^2\Sigma \rightarrow X^2\Sigma$ and $E^2\Sigma \rightarrow A^2\Pi$ and an inverted $^2\Delta$ state designated by J, which gives rise to the transition $J^2\Delta \rightarrow A^2\Pi$. Rotational analyses of the bands have been made and the molecular constants evaluated. The new data, although not decisive, support the higher value (8.2 eV) for the dissociation energy of CN. A.

535.333

1967. THE SPECTRA OF THE MANGANESE HALIDES IN THE BLUE-GREEN. W.Hayes.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1097-106 (Dec., 1955).

The bands of MnBr, MnCl and MnF in the region λ 4750-5200 A have been photographed under high dispersion. The spectrum of each molecule consists of two separate systems one of which is assigned to a Π-Σ transition. The second system of MnCl may also be assigned to a Π-Σ transition. It is suggested that the second MnF system arises from a transition of the type 0^+-Σ and the second MnBr system from a transition of the type 0^+-1. The isotope effect observed in MnBr and MnCl is described in detail. A table of the constants of the band systems of the manganese halides is included A.

535.338.332 : 539.152.2

1968. ON THE FINE AND HYPERFINE STRUCTURE OF THE RbII SPECTRUM AND THE NUCLEAR QUADRUPOLE MOMENT OF Rb^{87}. H.Kopfermann, A.Steudel and J.O.Trier.
Z. Phys., Vol. 144, No. 1-3, 9-12 (1956). In German.

The interpretation of the h.f.s. separations, observed with a Fabry-Perot interferometer, requires some modifications of the scheme of the fine structure terms previously given by Laporte, Miller and Sawyer (1931). From the study of seven terms of the configuration $4p^5 5p$, the quadrupole moment of Rb^{87} was found to be $(0.14 \pm 0.06)\ 10^{-24}\ cm^2$. L.Pincherle

535.338.333

1969. INVESTIGATION OF THE ISOTOPE EFFECT IN THE SPECTRUM OF URANIUM. A.R.Striganov and L.A.Korostȳleva.
Zh. éksper. teor. Fiz., Vol. 29, No. 4(10), 393-405 (1955). In Russian.

The isotope shift between lines of U^{238} and U^{235} is measured for 346 lines. The regularities obtained here are employed in the classification of the uranium spectrum, as well as for the determination of the isotope shift for several terms

in U I and U II. It is found that the lowest electronic configuration of U II is $5f^4 7s$. The odd–even shift is measured for several isotopes. G.E.Brown

535.338.333

1970. CALCULATION OF ISOTOPE SHIFTS IN THE SPECTRUM OF HELIUM. A.P.Stone.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1152-6 (Dec., 1955).

The isotope shift due to nuclear motion is calculated for the 2^1S, 2^3S terms of helium, using wave functions which take account of configuration interaction. Agreement is obtained with the experimental term shifts within the limits of experimental error. It is concluded that isotope shifts in helium are due mainly to nuclear motion. A.

535.34

1971. ON THE DETERMINATION OF ABSOLUTE INTENSITIES FROM SINGLE- AND MULTIPLE-PATH ABSORPTION MEASUREMENTS. S.S.Penner and H.Aroeste.
J. chem. Phys., Vol. 23, No. 12, 2244-7 (Dec., 1955).

The physical principles involved in conventional absolute intensity measurements are reviewed. Experimental difficulties rule out the use of extrapolation techniques for some spectral transitions. For this reason it is of interest to re-examine the possibility of using total absorption measurements, in conjunction with the curves of growth, for making intensity estimates. Extrapolation methods yield results which are independent of spectral line shape. Use of the curves of growth, on the other hand, implies the assumption that the line contour can be described by combined Doppler and Lorentz broadening. The curves of growth permit a unique correlation between total absorption and f-value either for spectral lines with pure Doppler broadening or for pure collision broadening. Furthermore, a simple experimental procedure can be devised for estimating both the absolute intensity and the spectral line profile on the basis of single-path and multiple-path absorption measurements. The suggested procedure involves absorption measurements for optical densities (path lengths) under conditions in which the integrated fractional absorption is a relatively sensitive function of spectral line shape. Representative calculations referring to utilization of the proposed method have been carried out for spectral lines belonging to the $^2\Sigma \rightarrow {}^2\Pi$ transitions, (0, 0)-band, of OH, and also for lines belonging to the fundamental vibration-rotation spectrum of CO. A.

535.343

1972. SPECTROSCOPIC PROPERTIES OF ORGANIC PHOTOCONDUCTORS. I. ABSORPTION SPECTRA OF CATIONIC DYE FILMS. J.W.Weigl.
J. chem. Phys., Vol. 24, No. 2, 364-70 (Feb., 1956).

The absorption spectra of solid films of six photoconductive dyes are reported. The transitions in the solid state correspond to those of the "isolated" cations in solution. However, the longest-wavelength singlet-singlet absorption band is split into components separated by 1000 cm^{-1} or more. Other bands are unaffected, except for a general decrease of osciallator strength. The results are interpreted in terms of light absorption by a single molecule, followed by exciton motion in the lowest excited state. A.

535.343

1973. ON THE ABSORPTION SPECTRUM OF N_2O IN THE EXTREME ULTRAVIOLET. N.Astoin and J.Granier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1736-8 (Dec. 14. 1955). In French.

An absorption curve is shown for the region 100 000–600 000 cm^{-1}. It consists of three band systems superposed on a continuum. The oscillator strength for the continuum is calculated as 5.6. G.F.Lothian

535.343

1974. ULTRAVIOLET ABSORPTION SPECTRUM OF BENZENE IN N-HEXANE AT PRESSURES TO 6000 BARS. W.W.Robertson and F.A.Matsen.
J. chem. Phys., Vol. 23, No. 12, 2468 (Dec., 1955).

The change due to pressure is similar to the change from vapour to solution with respect to broadening and magnitude and direction of wavelength shift. The wave-number shift is plotted against 1-1/K and the plot is not quite linear but seems to be continuous from liquid to vapour. C.Turner

535.343 : 535.333

1975. LONG WAVE ULTRAVIOLET SPECTRUM OF FORMALDEHYDE. A.D.Cohen and C.Reid.
J. chem. Phys., Vol. 24, No. 1, 85-8 (Jan., 1956).

The long wavelength spectrum has been investigated in absorption and in emission, both in the gas phase and in the condensed phase. Difficulties in the assignment of certain lines in the spectrum have been satisfactorily resolved. The temperature coefficient of the α band shows that it is a hot band arising from a lower state involving the 1280 cm^{-1} asymmetric vibration. A.

535.343

1976. ULTRAVIOLET AND INFRARED ABSORPTION SPECTRA OF SUBSTITUTED ACETOPHENONES AND BENZOIC ACIDS. J.Tanaka, S.Nagakura and M.Kobayashi.
J. chem. Phys., Vol. 24, No. 2, 311-15 (Feb., 1956).

Influences of substituents on the ultraviolet and infrared absorptions of acetophenone and benzoic acid are investigated from theoretical and experimental points of view. All theoretical considerations are made by the molecular energy-level diagram method developed by the authors. Ultraviolet absorption spectra of some substituted acetophenones are measured in n-heptane, alcohol, water and sulphuric acid. It is found that most molecules studied here have absorption bands corresponding to the $n \rightarrow \pi^*$ transition of the carbonyl group, $A_{1g} \rightarrow B_{2u}$ and $A_{1g} \rightarrow B_{1u}$ transition of the benzene ring, and intramolecular charge-transfer absorption. Especially concerning last absorption, a somewhat quantitative theoretical consideration is presented and satisfactory agreement is obtained between the theoretical and observed excitation energies. Infrared absorption spectra of carbonyl groups in substituted acetophenones are measured in carbon tetrachloride. The observed carbonyl frequencies are compared with the bond orders of this bond calculated on the basis of the above method. Good correlation is also found between these two quantities. A similar consideration is also made with substituted benzoic acids. A.

535.343

1977. INFRARED SPECTRUM OF HYDROGEN SULFIDE FROM 2200-2800 cm^{-1}. H.C.Allen, Jr, L.R.Blaine, E.K.Plyler and P.C.Cross.
J. chem. Phys., Vol. 24, No. 1, 35-8 (Jan., 1956).

The absorption spectrum was observed under high resolution. It can be accounted for by two bands having excited states $(n_1, n_2, n_3) = (0,2,0)$ and $(1,0,0)$. A novel feature of this analysis is the assignment of the strong absorption in the high-frequency portion of this region as arising from the transition $(0,0,0) \rightarrow (1,0,0)$. The parameters giving the best fits to the observed absorption are:

	A*	B*	C*	ν_0
(0,2,0)	11.099	9.443	4.610	2353.93 cm^{-1}
(1,0,0)	10.249	8.831	4.663	2614.56 cm^{-1}.

It was not possible to assign enough transitions in the (0,0,1) band to determine a unique set of parameters. A.

535.343

1978. NEAR INFRARED SPECTRUM OF NITROUS OXIDE. E.K.Plyler, E.D.Tidwell and H.C.Allen, Jr.
J. chem. Phys., Vol. 24, No. 1, 95-7 (Jan., 1956).

Twelve previously unreported bands of nitrous oxide have been observed under high resolution. The results of the anal-

yses of these bands are given. A precise value of $_2$ is derived from a difference band and four constants in the quadratic vibrational energy expression are given. The role of Fermi resonance is discussed briefly. A.

535.343

1979. INFRARED SPECTRA OF GASEOUS AND CRYSTALLINE CYANOGEN HALIDES. W.O.Freitag and E.R.Nixon.
J. chem. Phys., Vol. 24, No. 1, 109-14 (Jan., 1956).

The infrared spectra of gaseous ClCN and BrCN at room temperature are reported for the LiF, NaCl, KBr and CsBr prism regions. Several upper stage bands as well as bands due to C^{13} appear in both spectra. Assignments are given, from which a number of the vibrational constants are evaluated and the Fermi resonant levels treated by a first-order perturbation method. The spectra of crystalline ClCN, BrCN and ICN at -180°C are also recorded. Absorption bands, including several due to C^{13} and N^{15}, are assigned and the spectra are discussed in terms of the available X-ray crystal data. A.

535.343

1980. INFRARED SPECTRA OF SOME DEUTERATED SILANES. J.H.Meal and M.K.Wilson.
J. chem. Phys., Vol. 24, No. 2, 385-90 (Feb., 1956).

The infrared spectra of SiD_4, $SiHD_3$ and SiH_2D_2 have been observed in the region 2-16 microns. Values of ζ obtained for the 851 cm^{-1} band of $SiHD_3$ and the 1597 cm^{-1} band of SiD_4 are 0.76 and 0.10, respectively. Assignments are given for the observed bands and force constants are calculated. A.

535.343

1981. INFRARED SPECTRA OF SiO_2 FROM 400 TO 600 cm^{-1}. J.Reitzel.
J. chem. Phys., Vol. 23, No. 12, 2407-9 (Dec., 1955).

The frequencies of the infrared bands occurring between 400 and 600 cm^{-1} in quartz, α cristobalite, and vitreous silica have been determined by a reflection method. The observed infrared spectra are compared with published Raman data. A.

535.343

1982. SPECTROSCOPY OF GASEOUS CARBONYLS. I. INFRARED SPECTRA AND THERMODYNAMIC PROPERTIES OF CHROMIUM AND MOLYBDENUM HEXACARBONYLS. N.J.Hawkins, H.C.Mattraw, W.W.Sabol and D.R.Carpenter.
J. chem. Phys., Vol. 23, No. 12, 2422-7 (Dec., 1955).

Infrared spectra were obtained and spectra could be interpreted as resulting from an $X(YZ)_6$-type molecule of O_h-symmetry. Of the thirteen fundamental vibration frequencies possible, all but three are fairly well established. The fundamentals are shown to be of two distinct types: (1) those which are typical of a heavy outer atom octahedral molecule and (2) those which are typical of the carbon and oxygen moving in opposition to each other. Thermodynamic properties are computed for the ideal gases for various temperatures to 600°K. A.

535.343

1983. INFRARED SPECTRA OF CRYSTALLINE SYMTETRABROMO AND TETRACHLOROETHANE. R.E.Kagarise.
J. chem. Phys., Vol. 24, No. 2, 300-5 (Feb., 1956).

The infrared spectra of liquid and crystalline $CHBr_2CHBr_2$ and $CHCl_2CHCl_2$ have been obtained in the 2 to 36 micron region. It has been observed that $CHBr_2CHBr_2$ will crystallize as either trans- or gauche molecules, depending upon the method of cooling employed. To date, crystalline $CHCl_2CHCl_2$ has been prepared in the gauche-form only. On the basis of these data and previously reported Raman spectra, a partial assignment of the fundamental frequencies has been made. A.

535.343

1984. CHARACTERISTIC INFRARED BANDS OF MONOSUBSTITUTED AMIDES. T.Miyazawa, T.Shimanouchi and S.Mizushima.
J. chem. Phys., Vol. 24, No. 2, 408-18 (Feb., 1956).

Infrared spectra of various monosubstituted amides and the corresponding deuterated compounds have been measured in the gaseous, liquid, and crystalline states and in solutions. From the experimental results, the bands characteristic of the amide structure have been determined. Furthermore, from the comparison with the spectra of related substances and by the application of the product rule, the assignments of these characteristic bands have been made. The observed change of frequencies of these characteristic bands with change of state confirms this assignment. A

535.343 : 535.375.5

1985. VIBRATIONAL SPECTRA OF ORGANOSILICON COMPOUNDS. I. VINYLTRICHLOROSILANE. E.R.Shull, R.A.Thursack and C.M.Birdsall.
J. chem. Phys., Vol. 24, No. 1, 147-50 (Jan., 1956).

The Raman spectrum, including qualitative depolarizations of liquid vinyltrichlorosilane, and the infrared spectra of liquid and gaseous vinyltrichlorosilane have been obtained. The spectroscopic data indicate that the vinyltrichlorosilane molecule has C_S symmetry. An assignment of the observed frequencies has been made on the basis of this symmetry A.

535.343 : 535.375.55

1986. VIBRATIONAL SPECTRUM OF CF_3CN. W.F.Edgell and R.M.Potter.
J. chem. Phys., Vol. 24, No. 1, 80-5 (Jan., 1956).

The Raman spectrum of liquid CF_3CN has been obtained at -100°C. The infrared spectrum of the gas at room temperature has been obtained from 2 to 38 microns. The analysis of these data yields the fundamentals, which are used to interpret the overtone and combination bands. A qualitative discussion of the character of the vibrations, which is based upon comparison with other molecules of the CF_3X type, is given in terms of orthogonal characteristic vibrations. The results of a normal coordinate analysis are included. A.

535.343

1987. STRUCTURE OF THE ABSORPTION SPECTRA OF NICKEL SALTS IN SOLUTION. R.Lacroix.
Arch. Sci. (Geneva), Vol. 8, No. 3, 317-20 (1955). In French.

The wavemechanical calculation of the energy levels of $Ni(H_2O)_6^{++}$ is outlined. The results agree well with observed bands at 8300, 14 600 and 24 700 cm^{-1}. G.F.Lothian

535.343

1988. STRUCTURE OF THE ABSORPTION SPECTRUM OF TRIVALENT VANADIUM SALTS IN SOLUTION. R.Lacroix.
Arch. Sci. (Geneva), Vol. 8, No. 3,321-2 (1955). In French.

Following the procedure of the previous paper (preceding abstract), the energy levels of $V(H_2O)_6^{+++}$ are calculated, indicating bands at 16 400, 27 700 and 34 400 cm^{-1}; the first two have been observed. G.F.Lothian

535.345

1989. MULTILAYER FILMS FOR THE ULTRAVIOLET. W.L.Barr and F.A.Jenkins.
J. Opt. Soc. Amer., Vol. 46, No. 2, 141-2 (Feb., 1956).

A report on the use of antimony oxide and lead chloride for multilayer films for transmission in the ultraviolet. The combination of antimony oxide (Sb_2O_3) and cryolite is found to be good. Transmission curves are given from the visible down to the u.v. cut-off which in antimony oxide lies 80 A to the shorter wavelength than in the case of lead chloride. An 11-layer interference filter using antimony oxide and cryolite had a transmission of 93.6% at 3725 A with a band width of 100 A. The refractive index of the film of antimony oxide is considered to be about 2.1. Antimony oxide evaporates at slightly below

its melting point of 656° C and does not deteriorate with time. S.Tolansky

535.345 : 548.7

1990. THE ANISOTROPIC ABSORPTION OF THE VISIBLE BANDS IN IRRADIATED α-QUARTZ. E.W.J.Mitchell and E.G.S.Paige.
Phil. Mag., Vol. 46, 1353-61 (Dec., 1955).

Measurements have been made, using polarized light, of the anisotropy of the visible absorption of centres induced in quartz by X-ray, gamma and neutron irradiation. The ratio of the integrated absorption when the electric vector is parallel to the c-axis to that when it is perpendicular, is 1.5. An experiment is described which suggests that the optical absorption is associated with substitutional aluminium impurity. It is shown that a value of 1.3 would be expected from the O'Brien and Pryce model of the magnetic resonance centre which is induced under similar conditions. A.

535.371

1991. ANTIMONY OXIDE PHOSPHOR WITH RED EMISSION. Y.Kotera and T.Sekine.
J. Electrochem. Soc., Vol. 102, No. 7, 390-3 (July, 1955).

A phosphor consisting of antimony oxide, boric oxide, and manganese activator is fairly efficiently excited by ultraviolet radiation. It emits a band spectrum with a peak at 6400 A. The function of the boric oxide is to enhance fluorescent intensity, optimum composition being about 1 mole antimony oxide, 0.1 mole boric acid, and 0.002 mole manganese. Firing times, temperatures, and atmospheres (except hydrogen) are not critical. The structure of the phosphors is discussed on the basis of X-ray diffraction patterns. A.

535.371

1992. ROLE OF OXYGEN IN THE QUENCHING OF LIQUID SCINTILLATORS. H.H.Seliger, C.A.Ziegler and I.Jaffe.
Phys. Rev., Vol. 101, No. 3, 998-9 (Feb. 1, 1956).

The quenching effects of oxygen on the light outputs of several organic liquid scintillators have been compared under conditions of high-energy gamma irradiation and direct light excitation of the solute. The reduction by oxygen of the light output has been found to be primarily due to solute quenching. Results are obtained which support the collision-transfer mechanism proposed by Kallmann. A.

535.371 : 537.226.2

1993. DIELECTRIC CHANGES IN INORGANIC PHOSPHORS. S.Kronenberg and C.A.Accardo.
Phys. Rev., Vol. 101, No. 3, 989-92 (Feb. 1, 1956).

Phosphors of the ZnS-CdS type under an applied a.c. field exhibit capacity changes when illuminated. The measurements indicate that in some phosphors the change in capacity may not be attributed solely to a change in ohmic resistance. A possible explanation for the mechanism involved in these cases is given. Capacity decay data and photoconductivity decay at room temperature and liquid nitrogen temperature are discussed. Voltage-dependence data at various frequencies are also included. A.

535.372

1994. ON THE BAND WIDTH IN FLUORESCENCE SPECTRA OF ORGANIC MOLECULAR CRYSTALS. INVESTIGATIONS ON NAPHTHALENE MIXED CRYSTALS. H.C.Wolf.
Z. Phys., Vol. 143, No. 3, 266-73 (1955). In German.

Investigations on mixed crystals of naphthalene–anthracene show that excitation can spread over many lattice spacings. It is also shown that the position and intensity distribution of absorption and fluorescence bands are unaffected by added molecules, but that, because of energy transfer, the life time of the host-crystal excited state is decreased. The fluorescence spectrum of pure naphthalene is compared with that of mixed crystals containing 0.002-1% anthracene. Naphthalene fluorescence is strongly quenched and undetectable for 1%. Bands or lines are sharper in mixed crystals. Unsymmetrical broadening in pure naphthalene shifts the maximum to the red. The vibration frequency in the 0, 0 and 1st band is found to be 476 cm^{-1} (see also Abstr. 8811/1952 and Abstr. 7003/1953). The sharpening of the lines on addition of anthracene is attributed to hindering of the coupling of excited naphthalene molecules with the undisturbed lattice. J.Ewles

535.372

1995. LUMINESCENCE OF CRYSTALS AT LOW TEMPERATURES. NAPHTHALENE AT 20° K. A.Zmerli and P.Pesteil.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 938-40 (Oct. 10, 1955). In French.

Principal spectral bands were measured and are interpreted. An electronic transition of symmetry $^3B_{3u}$ gives the band at 32 400 cm^{-1}, combination with vibrations of symmetry β_{1g} give bands with symmetry B_{2u} while those of symmetry B_{3u} arise from combinations of vibrations of α_{1g}. The proposed scheme explains observed polarization and also band shifts on methylation. G.F.J.Garlick

535.375.54

1996. RAMAN SPECTRUM OF FROZEN SOLUTION OF CS_2 IN METHYL CYCLOHEXANE. S.C.Sirkar and G.S.Kastha.
J. chem. Phys., Vol. 23, No. 12, 2439 (Dec., 1955).

Measurements conducted at −180° C on 20% and 50% solns. of CS_2 in methyl cyclohexane indicate that the lines observed at 70 cm^{-1} and 81 cm^{-1} in the spectrum of solid CS_2 are due to oscillations in associated groups of molecules. G.I.W.Llewelyn

535.375.55

1997. ON THE EFFECT OF INTRAMOLECULAR HYDROGEN BONDS ON RAMAN SPECTRA. P.D.Simova and B.Skorchev.
Izv. Bulg. Akad. Nauk., Vol. 4, 47-72 (1954; publ. 1955). In Bulgarian with summary (1 p.) in German.

Measurements have been carried out on the Raman spectra of salicylaldehyde and methyl salicylate in solution in ether, methyl alcohol, dioxan, fluorobenzol and carbon tetrachloride. G.I.W.Llewelyn

535.375.56

1998. HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES. V. ROTATIONAL SPECTRA OF ALLENE, ALLENE-d_4 AND ALLENE-1, 1-d_2. B.P.Stoicheff.
Canad. J. Phys., Vol. 33, No. 12, 811-18 (Dec., 1955).

For Pt IV, see Abstr. 10973 (1954). The pure rotational Raman spectra were photographed in the second order of a 21 ft grating. Two plates of each spectrum were analysed yielding the following values for the rotational constants:
Allene: $B_0 = 0.2965_3 \pm 0.00008$ $cm.^{-1}$, $D_j = 11 \times 10^{-8}$ $cm.^{-1}$
Allene-d_4: $B_0 = 0.2323_0 \pm 0.0001$ $cm.^{-1}$, $D_j = 7.5 \times 10^{-8}$ $cm.^{-1}$
Allene-1, 1-d_2: $B_0 = 0.2619_0 \pm 0.0001$ $cm.^{-1}$, $D_j = 7.0 \times 10^{-8}$ $cm.^{-1}$
These constants lead to the value r_0 (C=C) = $1.308_8 \pm 0.001$ A. Also if a value of r_0 (C–H) = 1.07 ± 0.01 A is assumed, then $\angle$ HCH = $117 \pm 1.5°$. It is noted that the length of the carbon-carbon double bond in allene is significantly shorter than that in ethylene. A.

535.376

1999. LIGHT PATTERNS IN ELECTROLUMINESCENT ZnS SINGLE CRYSTALS ACTIVATED BY DIFFUSION OF Cu. G.Diemer.
Philips Res. Rep., Vol. 10, No. 3, 194-204 (June, 1955).

Non-activated ZnS single crystals can be made electroluminescent by providing them with copper electrodes through evaporation in vacuum. It is shown that at temperatures little above room temperature the copper diffuses rapidly along the surface of the crystal and along certain imperfections into the bulk of the crystal. During electroluminescence in an a.c. field light is emitted only from narrow lines, which with

high optical magnification prove to consist of a series of nearly equidistant dots. These "dotted lines of light" always have the same direction as the main direction of growth of the hexagonal crystals. A.

535.376

2000. SOME ASPECTS OF THE VOLTAGE AND FREQUENCY DEPENDENCE OF ELECTROLUMINESCENT ZINC SULPHIDE. P.Zalm, G.Diemer and H.A.Klasens.
Philips Res. Rep., Vol. 10, No. 3, 205-15 (June, 1955).

Experiment shows that the relation between the luminous emittance H of an electroluminescent cell and the applied r.m.s. voltage V is given by $H = H_0 \exp(-c/V^{\frac{1}{2}})$. A mechanism is proposed that may explain both the well-known linear frequency dependence at a constant r.m.s. voltage of the emittance and the observed voltage dependence. A.

535.376

2001. ENHANCEMENT OF THE ELECTROLUMINESCENCE OF CERTAIN CRYSTALS BY ROTATION IN THE FIELD. G.Destriau.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 869-70 (Oct. 3, 1955). In French.

The electroluminescence of a zinc oxide phosphor due to an applied electric field (a.c.) is enhanced by rotation of the phosphor in the field. The rotation does not alter the waveform of the emission but increases the amplitude. The effect may help to elucidate the process of ageing in such phosphors, which may arise from surface modifications of the crystal grains. G.F.J.Garlick

535.376

2002. ABSOLUTE SCINTILLATION EFFICIENCY OF ANTHRACENE CRYSTALS. G.T.Wright.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 929-37 (Nov., 1955).

The absolute scintillation efficiency of anthracene crystals excited with fast electrons is measured. The experimental method used avoids the errors existing in previous measurements which are due to the anisotropic refraction, spatial distribution and re-absorption of fluorescence in these crystals. At a temperature of 290°K the intrinsic scintillation efficiency (in the absence of re-absorption of fluorescence) is found to be 0.062 ± 0.004; this is reduced to 0.050 ± 0.005 for the crystal by self-absorption of fluorescence. Reasons for this low efficiency are discussed. A detailed description is given of excitation conditions produced in organic crystals by ionizing particles with a discussion of possible quenching mechanisms in the excitation column. For electrons these are considered to be due to internal molecular dissipation of electronic excitation energy, to mutual interaction between excited molecules and to the strong electric fields surrounding ions. For the heavy particles these processes are more pronounced and further quenching occurs due to thermal fields and to damaged molecules. The role of migration of excitation energy is also considered. This description of the scintillation process satisfactorily explains the low efficiencies and the decay shapes of fluorescence observed experimentally. A.

535.376

2003. FREQUENCY DEPENDENCE OF ELECTROLUMINESCENT BRIGHTNESS OF IMPURITY-QUENCHED PHOSPHORS. W.Lehmann.
Phys. Rev., Vol.101, No. 1, 489-90 (Jan. 1, 1956).

"Poisoning" of zinc sulphide phosphors by Fe, Ni or Co impurity decreases the general level of electroluminescence brightness without altering the form of the brightness–voltage relation. The impurity has a marked effect on the brightness versus applied field frequency relation and a "superlinear" dependence is observed. G.F.J.Garlick

535.377

2004. SAMARIUM-ACTIVATED CALCIUM SULPHATE AS A THERMOLUMINESCENT SYSTEM. N.Riehl and H.Keppel.
Naturwissenschaften, Vol. 42, No. 23, 624-5 (1955). In German.

$CaSO_4$–Sm phosphors are excited by X-rays, γ-rays or short-wavelength ultraviolet radiation, and are stimulated by radiation of longer wavelength ($\lambda < 0.55\,\mu$). Thermal glow peaks lie at temperatures above 100°C, following excitation at room temperature. G.F.J.Garlick

535.39

2005. REFLECTIVITY OF SEVERAL CRYSTALS IN THE FAR INFRARED REGION BETWEEN 20 AND 200 MICRONS. H.Yoshinaga.
Phys. Rev., Vol. 100, No. 2, 753-4 (Oct. 15, 1955).

The reflectivities of crystals of Ge, Si, InSb, ZnS, PbS, PbSe and TlCl have been measured in the region 20-200 μ, at room temperature and at about 100°C. InSb and ZnS show sharp maxima at 54.6 and 25.5 μ respectively, followed in InSb by flatter peaks at larger wavelengths. PbS, PbSe and TlCl all show two broad maxima in the 50-80 μ, and 100-150 μ regions. The reflectivity of Ge and Si is almost constant in the range covered. D.G.Avery

535.417

2006. MULTIPLE-BEAM INTERFERENCE AND EQUIDENSITIES. W.Krug.
Optik, Vol. 13, No. 1, 25-33 (1956). In German.

A general survey of the principles of multiple-beam interferometry as applied to the study of surface topography. This is followed by a description of the equidensity technique. In this interference fringes are photographed with two-beam systems and then the photographic plate is examined by a light-scattering technique which reveals the edges of the broad fringes as sharp lines. Comparison is made between the two systems and the information content in the multiple-beam fringes and in the equidensity fringes is discussed. S.Tolansky

535.417

2007. THE USE OF MIRRORS OF THIN DIELECTRIC FILMS FOR THE ULTRAVIOLET (REGION FROM 0.25 μ). G.Rimbert, R.Lennuier and J.L.Cojan.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1560-2 (Nov. 28, 1955). In French.

The use of Fabry–Perot etalons in the u.v. is limited by the absorption of the mirrors. Dielectric mirrors formed by multiple layers of cryolite and rubidium iodide are shown to have absorptions below 0.1 down to 2500 A. R.W.Fish

535.417

2008. HIGH-SPEED, DIRECT RECORDING FABRY–PEROT INTERFEROMETER. M.A.Biondi.
Rev. sci. Instrum., Vol. 27, No. 1, 36-9 (Jan., 1956).

An interferometer is described which has a high optical speed and provides a direct tracing of spectral line shapes on a linear scale. A photomultiplier views the centre spot of the interference pattern. The output of the photomultiplier goes to a vibrating-reed electrometer and then to a pen recorder. The wavelength of the light at the centre of the interference pattern is made to vary with time by changing the index of refraction between the interferometer plates. This is accomplished by enclosing the plates in a gas-tight housing and admitting an inert gas such as argon or helium to the housing. By the proper choice of gas and of the rate of pressure change one obtains the desired rate of tracing the line shape. Orders of magnitude reduction in "exposure" time are achieved by eliminating the use of photographic plates. A.

535.417

2009. CORRELATION BETWEEN PHOTONS IN TWO COHERENT BEAMS OF LIGHT. R.H.Brown and R.Q.Twiss.
Nature (London), Vol. 177, 27-8 (Jan. 7, 1956).

An interferometer using radio aerials which has formerly been used for measuring the angular diameter of radio stars

is modified for examination of optical wavelengths. It is suggested that the arrangement could be used with advantage for measuring the angular diameter of visual stars as it has proved to be largely free from the effects of ionospheric scintillation. A signal is picked up by two similar photocells. Correlations are secured when the photocells are correctly separated. The experiment shows that the photons in two coherent beams of light are correlated and this correlation is preserved in the process of photoelectric emission. It is established that the principle of the interferometer is sound and could be used for visual wavelength. S.Tolansky

535.42 : 534.213

DIFFRACTION PATTERNS PRODUCED BY SHEAR WAVES IN GLASS. See Abstr. 991.

535.42 : 534.321.9

2010. THE DIFFRACTION OF LIGHT BY TRAVELLING ULTRASONIC WAVES. III. THE RIGOROUS SOLUTION OF THE DIFFRACTION PROBLEM FOR DIVERGENT BUNDLES OF LIGHT (CYLINDRICAL WAVES). E.H.Wagner.
Z. Phys., Vol. 143, No. 3, 249-56 (1955). In German.

A continuation of Abstr. 268/1956. The diffraction is considered as a boundary value problem of Maxwell's theory. The diffraction field is represented by integrals, which can be solved by superposition of the corresponding solutions for plane waves. This theory is shown to explain some of the experimental results obtained by other workers. R.W.Fish

535.42 : 534.321.9

2011. THE DIFFRACTION OF LIGHT BY TRAVELLING ULTRASONIC WAVES. IV. THE DIFFRACTION FIELD AT A GREAT DISTANCE FROM THE CELL, WITH A DIVERGING PRIMARY BEAM. E.H.Wagner.
Z. Phys., Vol. 143, No. 4, 412-30 (1955). In German.

The integral representation of the diffraction field of a cylindrical wave obtained in Pt III is extended asymptotically to the case of the distant pattern in divergent light. The results are compared with the experimental phenomena discovered by Bergmann and Goehlich. R.W.Fish

535.421

2012. DIFFRACTION GRATING ANOMALIES. II. COARSE GRATINGS. C.H.Palmer, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 1, 50-3 (Jan., 1956).

For previous part, see Abstr. 4273 (1952). A preliminary study of the anomalies for coarse infrared reflection gratings ($d = 10.5\mu$) in the visible reveals the presence of many extremely strong anomalies for both the S and P polarization. The anomalies correspond, in some cases, to passing off orders as high as 42. Within experimental error the positions of the anomalies are given by the Rayleigh formula. The great strength of the P anomalies observed is in agreement with the author's earlier hypothesis that, unlike S anomalies, P anomalies can occur only when the depth of the rulings is comparable to or greater than the wavelength. A total of about six echelette gratings all showed extremely strong anomalies for both polarizations. A.

535.421

2013. THEORY OF THE ECHELETTE GRATING. I. R.D.Hatcher and J.H.Rohrbaugh.
J. Opt. Soc. Amer., Vol. 46, No. 2, 104-10 (Feb., 1956).

A formula for the spectral intensity distribution from the echelette grating is derived from the Kirchhoff theory and compared with previous derivations using the Huyghens approximation. Several numerical cases are calculated, and the formulae applied to the case of a plane surface. A.

535.434

2014. EXPERIMENTAL INVESTIGATIONS CONCERNING THE ILLUMINATION OF CLOUDS OF REFLECTING PARTICLES. N.Richter.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 80-8 (1955).

Solid particles in stars colloquium paper, see Abstr. 872 (1956). An experimental study of the dependence of brightness of a cloud of scattering particles, illuminated by parallel light, on phase-angle of illumination. Particles, 0.1 to 1.0 mm diameter, ranging from steel grains to poppy seeds, were investigated; and photoelectric measurements of brightness and polarization were made between phase-angles, 0 and 174 degrees. Only opaque particles are found to obey Lambert's law up to 100 degrees phase-angle. Of the materials tested, steel particles show the largest polarization, the max. of about 70%, being at p.a. 100-120 degrees. D.R.Barber

535.434

2015. MULTIPLE SCATTERING OF LIGHT ON THE DIELECTRIC SPHERES IMMERSED IN A LIQUID OF NEARLY THE SAME REFRACTIVE INDEX. P.Gosar.
Bull. sci. Cons. Acad. Yougoslavie, Vol. 2, No. 3, 73 (Nov., 1955).

An expression is deduced for the distribution of scattered light from a Christiansen filter of glass spheres large enough to permit the neglect of diffraction effects. G.F.Lothian

535.434 : 539.215.4

2016. EVALUATION OF ERRORS OF OPTICAL ORIGIN ARISING IN THE SIZE ANALYSIS OF A DISPERSION BY LIGHT TRANSMISSION. R.H.Boll and C.M.Sliepcevich.
J. Opt. Soc. Amer., Vol. 46, No. 3, 200-8 (March, 1956).

Due to relatively recent advances in theory, light transmission apparatus need not be calibrated against monodisperse standards in order to provide accurate size information for transparent spherical particles. However, the precision of construction necessary for accurate results has not heretofore been evaluated. In this paper the effects of unavoidable approximations in the optical construction of light transmission apparatus are evaluated quantitatively. Tables and graphs are presented which will enable the apparatus designer and user to avoid, or at least account for, errors in interpretation of light transmission data, without resort to empirical calibration. A.

535.55

2017. ON A PHOTOELASTIC TORSIOGRAPH. M.Bonvalet.
C.R. Acad. Sci. (Paris), Vol. 241, No. 13, 789-90 (Sept. 26, 1955). In French.

The arrangement used is described. A coating of a photoelastic resin covers a metal shaft which serves as a torsion meter. Linearly polarized light is incident in a direction normal to the axis of the shaft with the plane of vibration parallel to the shaft axis. After passage through the resin the light is reflected by the metal, again traverses the resin and then passes through an analyser into a photoelectric cell. The illumination received by the latter depends on the torsion in the shaft from which the applied couple can be found. Some results are briefly indicated. H.G.Jerrard

535.55

2018. IMPROVEMENT OF PHOTOELASTIC MEASUREMENT METHODS. M.Bonvalet.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1556-7 (Nov. 28, 1955). In French.

The author claims that by using photo-multipliers the sensitivity of the instrument described in the preceding abstract can be increased by a factor of 10. An example is given of measurements made on a duralumin tube. Other advantages are discussed. H.G.Jerrard

535.55

2019. PHOTO-ELASTIC DISPERSION IN CUBIC CRYSTALS. K.S.Iyengar.
Nature (London), Vol. 176, 1119-20 (Dec. 10, 1955).

The strain-optical coefficients at three wavelengths have been determined and tabulated for potassium bromide, potas-

sium chloride, lithium fluoride, lead nitrate, ammonium alum and potassium alum. In general they all show some dispersion. The coefficients for some optical glasses are also tabulated.
H.G.Jerrard

535.55 : 539.219.2

2020. THE OPTICAL POLARIZATION DETERMINATION OF THE PRINCIPAL STRESSES IN THE LOAD FREE SURFACE OF A THREE DIMENSIONAL MODEL BY THE INCLUSION-REMELT METHOD. H.H.Racké.
Z. angew. Phys., Vol. 7, No. 11, 516-23 (1955). In German.

The method with the requisite theory is described. The principle is the measurement of the deformation due to loading in the neighbourhood of a cylindrical inclusion of thermoplastic material in a model made from a photoelastic resin. The method is discussed and illustrated with photographs.
H.G.Jerrard

535.55 : 778.3

2021. A PHOTOGRAPHIC METHOD OF OBTAINING STRESS TRAJECTORIES. A.R.Morris.
Brit. J. appl. Phys., Vol. 7, No. 2, 59-61 (Feb., 1956).

A method of superimposing a set of photographs of isoclinics is described. With each isoclinic photograph is included a grid, the lines of which are inclined at an angle corresponding to that isoclinic parameter. These grid lines, being everywhere tangential to the principal stress directions, enable the stress trajectories to be easily and accurately drawn. A.

535.557 : 532.13 : 532.77

2022. EXPERIMENTAL STUDY OF THE OPTICAL AND FLOW PROPERTIES OF SOLUTIONS OF POLYSTYROLENES AS A FUNCTION OF THE VISCOSITY OF THE SOLVENT. J.Leray.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1741-3 (Dec. 14, 1955). In French.

The method is to study how the slope (tan α) of the tangent to the extinction curve at the origin, varies with changes in the viscosity of the solvent. Four samples of polystyrolene with molecular masses of 520 000; 1 200 000; 3 500 000 and 10 000 000, respectively were used and the results were related to earlier measurements by CERF (Thèse, Strasbourg) on two samples with smaller molecular masses viz. 130 000 and 200 000. The solvents varied in viscosity (η) from 0.65 (benzene) to 4.20 (a 10% solution of oligostyrene in cyclohexanone). A linear relationship was found to exist between tan α and . For a given polymer (mass M) tan = A_m f(c) $\eta + B_m$ when A_m and B_m are constants and f(c) varies with the concentration.
J.Iball

535.557 : 532.52

STREAMING BIREFRINGENCE AS A HYDRODYNAMIC RESEARCH TOOL. See Abstr. 953.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.8

2023. A WIDE RANGE SCHLIEREN SYSTEM. H.Jeffree.
J. sci. Instrum., Vol. 33, No. 1, 29-30 (Jan., 1956).

The Schlieren optical system is well known to be a simple and sensitive method of displaying variations in air density, such as are found, for instance, in the flow of air through a wind tunnel. Normally, a choice must be made between high sensitivity to show fine detail and long range so that main features are not lost or distorted. Methods are given whereby both high sensitivity and fine detail are obtained simultaneously. It is even possible to obtain unambiguous measurements through glass windows not initially designed for Schlieren work; or to show fine striations in all parts of a sheet of glass which has also larger surface irregularities. A.

535.81 : 535.39

2024. TRANSISTOR OPERATED NULL INDICATOR FOR USE WITH THE MULTIPURPOSE REFLECTOMETER. G.L.Gibson.
J. Opt. Soc. Amer., Vol. 46, No. 2, 144 (Feb., 1956).

535.822.17

2025. ON THE BASIC APPROXIMATION IN THE THEORY OF THE PHASE CONTRAST MICROSCOPE. F.D.Kahn.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1073-80 (Dec., 1955).

Maxwell's equations are used to find a necessary condition which must be satisfied in order that the phase-contrast microscope may function satisfactorily. The method in the paper requires no restriction to be placed on the general shape of the object to be examined: in particular it need not have a grating-like structure. A.

535.862

2026. A SIMPLE PERISCOPE SYSTEM FOR REMOTE OPERATIONS. A.G.Silvester.
Nucleonics, Vol. 13, No. 11, 80-1 (Nov., 1955).

A low cost periscope, using front-surfaced optically flat mirrors, is described. Periscopes of this type have been used to view fields inside a cell with 6 ft. shielding walls. The system uses bearings designed to work without lubricants (which might break down in high radiation fields). A microscope and cathetometer are used with the periscope to measure to 10^{-4} in.
L.R.Shepherd

535.89 : 545.82

2027. INVESTIGATIONS ON LIGHT SOURCES FOR SPECTRO-CHEMICAL ANALYSIS. X. NEW HIGH-VOLTAGE SPARK SOURCES WITH MECHANICAL CONTROL. Á.Bardócz.
Z. angew. Phys., Vol. 7, No. 11, 523-7 (1955). In German.

For Pt VIII, see Abstr. 6978 (1955). Describes various circuits for the production of controlled sparks for analytical purposes. Rotary spark gaps are used for tripping, with the test gap in some form of series arrangement. Typical oscillograms, showing the voltages at specified points in the circuits, are shown.
J.D.Craggs

HEAT 536

536.21 : 536.311.3

2028. THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF DEPOSITED CARBON. A.R.G.Brown, W.Watt, R.W.Powell and R.P.Tye.
Brit. J. appl. Phys., Vol. 7, No. 2, 73-6 (Feb., 1956).

Details are given of a method used to deposit carbon from hydrocarbons at high temperatures for the production of small tubular specimens. The density had been found to vary systematically with the temperature of deposition, and the present work relates to measurements of thermal conductivity and electrical resistivity made over the range 20 to 200°C on commercial graphite and deposited carbons formed at temperatures of 1800, 1900, 2000 and 2100°C. The thermal conductivities of the specimens deposited at 2000 and 2100°C were found to be exceptionally high. At 50°C the value for material deposited at 2000°C was approximately 20% greater that that of copper; for material deposited at 2100°C it was approximately 40% greater than that of copper. These measurements were made in a direction parallel to the axis of the tube for which direction the deposited carbon showed a pronounced layered structure. This, and an associated high electrical resistance normal to its plane, made it difficult to determine the electrical resistivity of the sample deposited at 2100°C. The high thermal conductivity appears to result from the high lattice conductivity of this material, the electronic component being only of the order of 1%. A.

536.212 : 539.11

2029. THE EFFECT OF FREE ELECTRONS ON LATTICE CONDUCTION. J.M.Ziman.
Phil. Mag. (Ser. 8), Vol. 1, 191-8 (Feb., 1956).

The scattering of phonons by electrons is calculated, assuming the usual electron—phonon interaction, for a parabolic band whose degeneracy temperature is comparable with the temperature of the lattice. The contribution to the thermal resistance is given by an exact formula, subject only to justifiable assumptions concerning phonon—phonon interactions. With rising temperature the apparent mean free path of the phonons at first decreases as $1/T$ (or, if there are very few electrons, as $\exp(a/T)$), but reaches a minimum and then increases as T^2. Energy and momentum conservation then allow only the tail of the electron distribution to contribute to the scattering. The model is thought to apply to certain observations on p-type germanium, irradiated sapphire and conducting diamond. A.

536.212.2 : 537.312.62

2030. THERMAL CONDUCTIVITY OF INDIUM-THALLIUM ALLOYS IN THE NORMAL AND SUPERCONDUCTING STATES. N.E.Phillips.
Phys. Rev., Vol. 100, No. 6, 1719-25 (Dec. 15, 1955).

Thermal conductivity measurements have been made on three indium-thallium alloys between 0.15° and 0.8°K. Temperature gradients were measured using carbon resistance thermometers. The alloys were of the type which show an increase in thermal conductivity on entering the superconducting state. At temperatures below 1°K the superconducting state thermal conductivity decreases rapidly with decreasing temperature, becoming roughly proportional to T^3 and to the grain size in the specimens at the lowest temperatures. The data are interpreted as meaning that phonon conductivity limited by boundary scattering is important in this region. A.

536.22/.23

2031. THE THERMAL CONDUCTIVITY OF LIQUID AND GASEOUS OXYGEN. H.Ziebland and J.T.A.Burton.
Brit. J. appl. Phys., Vol. 6, No. 12, 416-20 (Dec., 1955).

Using a vertical coaxial cylinder method, the thermal conductivity of liquid and gaseous oxygen was measured at temperatures between 80 and 200°K at pressures between 1 and 130 atm. The results are compared with those of other authors. A.

536.25 : 532.5

2032. ON THE APPLICATION OF EIGENFUNCTION EXPANSIONS TO THE PROBLEM OF THE THERMAL INSTABILITY OF A FLUID SPHERE HEATED WITHIN. G.E.Backus.
Phil. Mag., Vol. 46, 1310-27 (Dec., 1955).

The eigenvalue problem which describes the onset of convection in a fluid sphere heated within is solved by means of expansions of the convective velocity field and temperature in spherical Bessel functions. The Rayleigh number $C_{l,n}$, at which there first appears the nth radial convection pattern with the spherical symmetry of the lth spherical harmonic, can be computed for any l and n by this device, and bracketed to arbitrary accuracy. A table of $C_{l,n}$ for l from 1 to 6 and n = 1 and 2 is compared with Chandrasekhar's values of $C_{l,1}$ obtained by a variational method. A similar attack is shown to succeed on the classical Rayleigh—Benard problem of convection in a horizontal layer of fluid. Finally, the class of problems which should be amenable to such an attack is delineated. A.

536.3 : 535.231.4

EMISSIVITIES AND ABSORPTIVITIES OF SOME COMMERCIAL SURFACES AT ROOM AND LIQUID NITROGEN TEMPERATURES. See Abstr. 1020.

536.33.08 : 537.312.62

2033. THE SUPERCONDUCTING BOLOMETER AS A DETECTOR OF THERMAL RADIATION FROM LOW-TEMPERATURE SOURCES. J.A.Hulbert and G.O.Jones.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 801-4 (Nov., 1955).

A superconducting bolometer has been developed as a detector of the thermal radiation from low-temperature sources. With an area of 1 cm^2, it has a sensitivity of about 3×10^{-12} watt absorbed for a time-constant of 20 sec. It has been used in preliminary observations of the optical properties of a graphite-coated surface at about 4°K, using radiation emitted from a source at a temperature between 9° and 17°K and assumed to lie mainly between 0.2 and 0.4 mm in wavelength. A.

536.41 : 536.42 : 536.63

2034. THE TRANSITION POINTS OF AMMONIUM DICHROMATE CRYSTALS. J.Jaffray.
C.R. Acad. Sci. (Paris), Vol. 241, No. 17, 1114-15 (Oct. 24, 1955). In French.

Transitions occur near 128, 155 and 268°K as shown by specific heat anomalies, probably without latent heat. The specific volume appears to be continuous for the three transitions, but that at 128°K is accompanied by discontinuities in length, the magnitude and sign depending upon orientation. These are such that the volume does not change. F.E.Hoare

536.413.2

2035. EFFECT OF STRESS ON THE EXPANSION COEFFICIENT. A.R.Rosenfield and B.L.Averbach.
J. appl. Phys., Vol. 27, No. 2, 154-6 (Feb., 1956).

The expansion coefficients of specimens under tensile stress and after the stress has been removed have been measured for three steels (0.20, 0.40, 0.80% carbon) and for two types of Invar. If the applied stress is below the elastic limit the change in expansion coefficient α, with stress σ is shown to be given by $(\partial\alpha/\partial\sigma)_T = -1/E^2(\partial E/\partial T)_\sigma$ where E is Young's modulus and T the temperature; if the stress is removed the expansivity returns to its original value. When the applied stress exceeds the elastic limit, there is a discontinuous change in expansion coefficient, and the expansivity on unloading differs from the original value. The lattice distortion associated with the onset of even a slight plastic strain (2×10^{-6}) appears sufficient to change the expansion coefficient both under load and after the load is removed. A.

536.413.2 : 548.0

2036. ON THE EXPANSION BEHAVIOUR OF SINGLE CRYSTALS OF α-URANIUM. P.Lehr and J.P.Langeron.
C.R. Acad. Sci. (Paris), Vol. 241, No. 17, 1130-3 (Oct. 24, 1955). In French.

The linear coefficient of expansion has been studied as a function of crystal orientation. Curves of expansion coefficient v. temperature were found to prove reversible over the range 20-600°C. Values are quoted for the coefficients along the three principal axes. W.Bardsley

536.421.1

2037. MELTING CURVES OF H_2, D_2 AND T_2 UP TO 3500 kg/cm^2. R.L.Mills and E.R.Grilly.
Phys. Rev., Vol. 101, No. 4, 1246-7 (Feb. 15, 1956).

The melting pressure—temperature relationship of the three isotopes has been determined accurately to 3500 kg/cm^2 by the blocked-capillary method. The data were fitted with fair success to the Simon-type equation, $P = a + bT^c$. The melting curves of H_2, D_2 and T_2 are displaced downward on the pressure axis in that order and, at identical temperatures, exhibit approximately equal slopes. A.

536.422.1

2038. THE EVAPORATION OF CARBON. P.Goldfinger.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 378-85 (1955). In French.

Solid particles in stars colloquium paper, see Abstr. 872 (1956). It is shown that recent results of evaporation measure-

ments on graphite are compatible with the thermodynamic properties of C, C_2, C_3, and C_5 provided that their respective heats of evaporation are taken to be 170, 200, 200 and 230 kcal/mole. Consideration is given to the exothermic bimolecular exchange reaction which leads to the formation of C atoms in flames, and in stars, viz. $2CH = C + CH_2$; and also reactions of the form $C_X + CH = C_{X+1} + H$, which lead to soot formation. D.R.Barber

536.423.1 : 536.44

2039. BOILING POINT AND CRITICAL TEMPERATURE OF N-PARAFFINS. V.S.Gupta.
J. chem. Phys., Vol. 24, No. 1, 164-5 (Jan., 1956).

536.424.1

2040. INVESTIGATION OF A TRANSITION OF CRYSTALS OF BERYLLIUM OXYFORMIATE. J.Jaffray and R.Bertrand.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1269-70 (Nov. 7, 1955). In French.

The transition occurs at +6° C, and is of the second order, with an anomalous change in specific heat and expansion without change in structure. C.Turner

536.461 : 535.4

PHASE CONTRAST OBSERVATIONS OF FLAMES. See Abstr. 1123.

536.48

2041. PROPERTIES OF THE LIGHT ISOTOPE OF HELIUM, He^3, AT LOW TEMPERATURES. I. R.A.Chentsov.
Uspekhi fiz. Nauk, Vol. 55, No. 1, 49-50 (1955). In Russian.

Survey article, in the main historical. 57 refs. C.R.S.Manders

536.48

2042. PROPERTIES OF THE LIGHT ISOTOPE OF HELIUM, He^3, AT LOW TEMPERATURES. II. R.A.Chentsov.
Uspekhi fiz. Nauk, Vol. 55, No. 2, 265-87 (1955). In Russian.

Gives an account of the theory of He^3 and of liquid mixtures He^3—He^4. Nearly 200 refs. given chronologically for each section of the survey. C.R.S.Manders

536.48

2043. THE LIQUID 'CELL' MODEL APPLIED TO ^{3}He. H.N.V.Temperley.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1136-44 (Dec., 1955).

It is shown that a sum of suitably chosen Debye and Schottky functions leads to a Gibbs free energy that satisfactorily represents the entropy, specific heat, and vapour pressure of liquid He^3. It is further shown that such a free energy is a plausible consequence of the 'cell' model of the liquid. The model can be developed consistently with symmetry requirements by using the 'pair-wise' approximation of the Heitler—London—Heisenberg theory of ferromagnetism, in a way that enables the magnetic susceptibility to be described quantitatively. The model predicts that the lowest state of liquid He^3 is an antiferromagnetic one of zero entropy, and that a transition should occur at 0.1° to 0.2° K. A comparison is made with the 'imperfect Fermi gas' model considered earlier, which, although it can be further improved in various ways, seems to be inferior to the present one. A.

536.48

2044. ATOMIC DISTRIBUTION IN LIQUID HELIUM-3. R.M.Mazo and J.G.Kirkwood.
Phys. Rev., Vol. 100, No. 6, 1787 (Dec. 15, 1955).

The radial distribution function of He^3 at absolute zero is derived by means of classical statistical mechanics; in these calculations the temperature is assumed to be 12.5° K in order to take the zero-point energy into account. Similar calculations are carried out for He^4. The angular intensity distribution for X-ray scattering is subsequently derived by Fourier transformation. The authors present their results without any comment in a graph together with an experimental intensity curve for He^4. R.Eisenschitz

536.521

2045. HIGH-SPEED RADIATION PYROMETER. J.Vollmer, J.Duke and C.Wysocki.
J. Opt. Soc. Amer., Vol. 46, No. 3, 215-17 (March, 1956).

The response time for 98% response is less than or equal to 0.5 sec. It is compensated for ambient temperature effects, is transient free and makes use of existing charts and scales when used with null-balance electronic potentiometers. A.

536.531

2046. A PLATINUM RESISTANCE THERMOMETER FOR USE AT LOW TEMPERATURES. C.R.Barber.
J. sci. Instrum., Vol. 32, No. 11, 416-17 (Nov., 1955).

A platinum resistance thermometer of external dimensions 75 x 2.5 mm is described. The resistance coil is sealed in a thin-walled platinum sheath in an atmosphere of helium by means of a lead glass to platinum seal. The reproducibility of reading is shown to be ± 0.001 deg C at the ice point after a number of temperature cycles down to −260° C over a period of 16 months. A.

536.626

2047. AN ISOTHERMAL MICRO-CALORIMETER. J.B.Stott.
J. sci. Instrum., Vol. 33, No. 2, 58-63 (Feb., 1956).

A calorimeter is described which, although nearly isothermal and independent of the specific heats of the materials employed, can still be used over a wide range of temperatures and makes use of a bank of thermocouples to measure the heat evolved. An attempt is made to obtain the maximum theoretical sensitivity by making most of the heat produced pass down the thermocouples. The high rate of heat transfer down the thermocouple wires has made it possible to pass up to 15 cm^3/min of air through the calorimeter without affecting the sensitivity. A.

536.629 : 539.172.4

2048. A CALORIMETER FOR MEASURING ENERGY ABSORPTION FROM PILE RADIATION. A.R.Anderson and R.J.Waite.
J. sci. Instrum., Vol. 33, No. 2, 46-51 (Feb., 1956).

An adiabatic calorimeter has been designed for the measurement of energy absorption from pile radiation. Some of the unusual problems encountered in this type of calorimetry are discussed. The preliminary work leading to a suitable design of calorimeter is summarized and full descriptions of the instrument and measurement techniques are given. Electrical calibrations of three samples with widely different thermal conductivities have demonstrated the satisfactory behaviour of the calorimeter over a wide range of power inputs. The results of some measurements in the Harwell pile B.E.P.O. are briefly discussed. A.

536.631 : 536.48

2049. THE LOW TEMPERATURE (11°-20° K) SPECIFIC HEAT OF α AND β MANGANESE. G.L.Booth, F.E.Hoare and B.T.Murphy.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 830-2 (Nov., 1955).

The specific heat of α Mn varies from 0.10 joule $mole^{-1}$. deg^{-1} at 12° K to 0.49 joule.$mole^{-1}$.deg^{-1} at 20° K; the corresponding values for β Mn are 0.62 joule.$mole^{-1}$.deg^{-1} and 1.18 joule.$mole^{-1}$.deg^{-1}. A plot of C_V/T against T^2 for α Mn yields a straight line and a value, the electronic heat coefficient, of 28 x 10^{-4} cal.$mole^{-1}$.deg^{-2} (118 x 10^{-4} joule.$mole^{-1}$. deg^{-2}). In the case of β Mn a similar plot shows a marked curvature below about 15° K and hence does not allow of the derivation of a value for γ. A.

536.631 : 538.221

SPECIFIC HEAT OF $MnCl_2$ AT LIQUID HELIUM TEMPERATURES. See Abstr. 1374.

THERMODYNAMICS 536.7/.8

536.7

2050. MECHANICAL QUANTITIES AND LOCAL THERMODYNAMIC PROPERTIES IN STATISTICAL THERMODYNAMICS. D.Massignon.
C.R. Acad. Sci. (Paris), Vol. 241, No. 20, 1381-4 (Nov. 14, 1955). In French.

A new method of using the classical canonical distribution function to express thermodynamic derivatives in terms of fluctuations in H and $\partial H/\partial V$, H being the Hamiltonian and V the volume. The argument is extended to show that the thermodynamic relations for local properties can be obtained without using the grand canonical ensemble. R.O.Davies

536.7 : 539.152.2

THERMODYNAMICS OF IRREVERSIBLE PROCESSES AND THE OVERHAUSER NUCLEAR POLARIZATION EFFECT. See Abstr. 1478.

536.71

2051. EQUATIONS OF STATE OF ELEMENTS FROM THE THOMAS–FERMI THEORY. II. CASE OF INCOMPLETE DEGENERACY. N.H.March.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1145-51 (Dec., 1955).

The work described in Pt I of the series (Abstr. 8721/1955) has been used to discuss the modified equations of state of elements given by the Thomas–Fermi method generalized to deal with non-zero temperatures. The equation of Marshak and Bethe can be solved in the limit of very high pressures by a Taylor expansion around the boundary point. The limiting forms of the thermodynamic functions given by Gilvarry are then regained and the present method enables these to be generalized. The equation is also solved numerically for three cases and a comparison of the results is made with the formulae given by Gilvarry. Some modifications of these are suggested and reliable results for the equations of state according to the Thomas–Fermi method are thus made available. A.

ELECTRICITY 537

ELECTROSTATICS. DIELECTRICS 537.2

537.21

2052. DEMONSTRATION IN STATIC ELECTRICITY. R.G.Cunningham and D.J.Montgomery.
Amer. J. Phys., Vol. 24, No. 2, 54-5 (Feb., 1956).

A set of Nylon or other textile filaments, supported by a pair of standoff insulators, can be used to demonstrate the effects of static electricity. Several methods of charging and discharging the filaments are described. A.

537.212 : 538.12

2053. THE ENERGY OF ELECTRIC AND MAGNETIC FIELDS. D.Park.
Amer. J. Phys., Vol. 24, No. 2, 78-81 (Feb., 1956).

Discusses the transition from the idea of the mutual potential energy of a static system of charges or currents to that of energy storage in a field. The argument is given first in a very simple form, where the transition can be made obvious, and this is followed by a more general discussion of the case in which permittivity and permeability are not independent of the applied fields. A.

537.213 : 537.3

2054. ELECTROSTATIC DYNAMOMETER. N.C.Little.
Amer. J. Phys., Vol. 24, No. 1, 26-9 (Jan., 1956).

Three forms of an instrument which combines the functions of the absolute electrometer and the current balance are described. The theory of this instrument and its application in determining current, potential, and resistance in the intermediate course in electricity and magnetism are discussed briefly. A.

537.222 : 536.7

THERMODYNAMICS OF A FLUID SUBSTANCE IN THE ELECTROSTATIC FIELD. See Abstr. 1182.

537.222.2

2055. SPACE CHARGE PHENOMENA IN LIQUID DIELECTRICS. D.W.Goodwin.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 61-9 (Jan., 1956).

By means of the electro-optical Kerr effect, distortion by space charge of the uniform potential gradient between electrodes in purified chlorbenzene has been observed. Evidence is presented suggesting that the conduction process occurs in filaments. The modified distribution of field strength is in qualitative agreement with a previous theory. A.

537.223.1 : 533.16

DESIGN OF A ROTATING-DISK ELECTROSTATIC GENERATOR WITH REDUCED FRICTIONAL LOSSES. See Abstr. 964.

537.224 : 537.311.3

2056. CIRCUIT FOR MEASURING HIGH RESISTANCE OR LOW CAPACITANCE. H.J.Kersten and E.W.Klingenberg.
Amer. J. Phys., Vol. 24, No. 1, 1-2 (Jan., 1955).

A convenient circuit for making linear measurements of high resistances and low capacitances consists of a conventional power supply, a relaxation oscillator, and a flip-flop circuit for alternately connecting and disconnecting a seconds timer. The relaxation oscillator makes use of the WL 759 cold-cathode, glow-discharge tube. A.

537.226

2057. NOTE ON THEORIES OF TIME-VARYING SPACE-CHARGE POLARIZATION. J.R.Macdonald.
J. chem. Phys., Vol. 23, No. 12, 2308-9 (Dec., 1955).

The nonlinearity of the differential equations governing space-charge buildup or decay cause the principle of superposition to be inapplicable. Thus, charging and discharging curves should differ and depend strongly on applied voltage when space-charge formation is appreciable. Two approximate theories of space-charge formation and decay are compared, and it is found that one of their main differences is that one has been partly linearized while the other has not. Finally, it is mentioned that of the several theories of the a.c. response of materials with space charge, only one has not been linearized; hence, it is the only one applicable for applied voltages above about kT/e. A.

537.226.1.08

2058. LINE BROADENING AND DIELECTRIC RELAXATION IN COMPRESSED GASES. C.S.E.Phillips.
J. chem. Phys., Vol. 23, No. 12, 2388-94 (Dec., 1955).

An attempt is made to investigate the transition from resonance to relaxation spectrum by high-pressure research in the microwave region. Equipment has been developed for studying the dielectric constant and loss of gases and liquids in the K-band region up to 1000 atm at temperatures up to 300^0 C. Measurements on a nearly spherical molecule of strong dipole moment ($CHClF_2$), on a linear molecule of weak dipole moment (N_2O), and on mixture of $CHClF_2$ with nitrogen are reported and a preliminary discussion of the results is given. A.

537.226.2 : 538.566.2

2059. THE REFRACTIVE INDICES OF WATER VAPOUR, AIR, OXYGEN, NITROGEN AND ARGON AT 72 kMc/s. K.D.Froome.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 833-5 (Nov., 1955).

The refractive indices of water vapour, air, oxygen, nitrogen and argon have been measured in a cavity resonator at a frequency of 72 kMc/s (corresponding to a wavelength of 4.16 mm). By comparing the values obtained at this frequency with those previously established at lower microwave frequencies it is found that the refractive indices for air, oxygen and water vapour are modified in much the manner to be expected from dipole theory, whereas those for nitrogen and argon remain unchanged. A.

537.226.2

2060. ON DIELECTRIC PROPERTIES OF SOLID HYDROGEN AND DEUTERIUM HALIDES. S.Havriliak, Jr and R.H.Cole.
J. chem. Phys., Vol. 23, No. 12, 2455-6 (Dec., 1955).

ϵ' and ϵ'' measurements were made from 20 c/s to 500 kc/s from 63°K to the melting points and the following transition points with lambda-type curves observed:- HBr 89°K, $\epsilon_0 = 200$; DBr 93°K, $\epsilon_0 = 210$; HI 70°K, $\epsilon_0 = 28$; DI 76°K, $\epsilon_0 = 23$. Circular arc complex plane loci are obtained below the transition points, but semicircles indicate that a single relaxation time is present above the transitions. D.H.Whiffen

537.226.2

2061. PRESSURE COEFFICIENT OF THE DIELECTRIC CONSTANT OF WATER. J.G.Mavroides.
J. chem. Phys., Vol. 24, No. 2, 398-9 (Feb., 1956).

Theoretical calculations have been made based on the following models: (a) water molecules considered as tetrahedrally packed (one-state model) and (b) water molecules considered as packed in two ways: tetrahedrally and simple close-packed (two-state model). These calculations are compared with experiment. The pressure coefficient has been measured by a newly derived dynamic method in which the pressure is applied ultrasonically. The measurement compares favourably with previously published values which were obtained with static pressures. A.

537.226.2

2062. FERRO-ELECTRIC CERAMIC WITH SHARPLY DEFINED NONLINEAR PROPERTIES. T.N.Verbitskaya.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 1, 29-33 (1955). In Russian.

Results of experimental investigation of variation of magnitude of permittivities of $BaTiO_3$ and ferroelectrics T-7500 and Varikond VK-I, in a range of alternating and constant fields, are graphically represented. The permittivity of T-7500 (maximum value 7500) is subject to time ageing. The permittivity of Varikond VK-1 increases from 4000 to a maximum of 20 000 under 0.5-0.7 kV per cm at 1000 c/s. VK-1 has been used in a tubeless audio-frequency amplifier to obtain amplification factor of 5000. J.Lukaszewicz

537.226.2

2063. THEORY OF SPONTANEOUS DEFORMATION OF BARIUM TITANATE. W.Kinase and H.Takahashi.
J. Phys. Soc Japan., Vol. 10, No. 11, 942-52 (Nov., 1955).

The spontaneous ferroelectric deformation of the $BaTiO_3$ crystal to tetragonal form is calculated, taking account of electrostatic energy and short-range interaction of the type $\lambda r^{-9} - \mu r^{-6}$, but neglecting the effect of thermal motion. It can be deduced that ionic shift causes the lattice spacing to extend a few per cent in the same direction (i.e. the direction of spontaneous polarization. The result is sensitive to the choice of the "effective charge" of the Ti ion. However, for a certain range of this parameter, the dependence on it of the lattice constant shows a striking resemblance to the observed dependence of the lattice constant on temperature. Contraction perpendicular to the direction of polarization is also calculated, taking into consideration interaction among ions. Extension and contraction can be shown to occur suddenly when the dipole interaction becomes stronger than some critical value. By taking a proper value for the dipole interaction energy the result can be made to agree with the experimental data. A.

537.226.2

2064. ON FERROELECTRIC BARKHAUSEN PULSES OF ROCHELLE SALT. R.Abe.
J. Phys. Soc. Japan, Vol. 11, No. 2, 104-11 (Feb., 1956).

Ferroelectric Barkhausen pulses were observed when an electric field was applied on a Rochelle salt crystal. The volume corresponding to a pulse and the dependence of the number of the pulse on temperature, humidity and strength of applied electric field were studied. It is found in the present experiment that the volume is the order of 10^{-9} cm^3 which is in accordance with Kojima and Kato's result. It is also found that the critical field at which pulses begin to take place is proportional to the n'th power of spontaneous polarization. The value of n determined from the experiment is 2.7 ± 0.5. This result can be explained satisfactorily assuming that walls are stabilized at hollows in a crystal before a field is applied on the crystal. A.

537.226.2

2065. PROPERTIES OF GUANIDINE ALUMINUM SULFATE HEXAHYDRATE AND SOME OF ITS ISOMORPHS. A.N.Holden, W.J.Merz, J.P.Remeika and B.T.Matthias.
Phys. Rev., Vol. 101, No. 3, 962-6 (Feb. 1, 1956).

Guanidine aluminium sulphate hexahydrate $(CN_3H_6)Al(SO_4)_2 \cdot 6H_2O$ is ferroelectric from as high a temperature as it will stand for a short time (about 200°C), down to temperatures of liquid N_2, the lowest employed. The crystal is trigonal, with the ferroelectric polarization along the trigonal axis. The 60-cycle hysteresis loops are often biased or have the character of double loops. The shape of the loop is correlated with the location of the specimen in the mother crystal. At room temperature the saturation polarization is about 0.35 microcoulomb/cm^2, the coercive force at 60 c/s is about 1000-3000 V/cm. These quantities increase with decreasing temperature. The small signal dielectric constant is about 6 along the axis and about 5 perpendicular to it. Of isomorphous substances, those so far examined in which D_2O replaces H_2O, in which Ga^{+3} and Cr^{+3} replace Al^{+3} and in which $(SeO_4)^{2-}$ replaces $(SO_4)^{2-}$, show essentially the same properties. The switching characteristics resemble those of $BaTiO_3$ but the present crystals are considerably slower. A.

537.226.2

2066. BEHAVIOR OF FERROELECTRIC $KNbO_3$ IN THE VICINITY OF THE CUBIC-TETRAGONAL TRANSITION. S.Triebwasser.
Phys. Rev., Vol. 101, No. 3, 993-7 (Feb. 1, 1956).

The results of measurements on single crystals of $KNbO_3$ are repored. From the dielectric constant and spontaneous polarization measurements the coefficients of the first three terms of the free energy expressed as a power series in the polarization can be found. The detailed behaviour of single domain crystals in the cubic and tetragonal phases is compared with Devonshire's phenomenological treatment. Agreement with predicted dielectric constant and spontaneous polarization is reasonable. The constants of $KNbO_3$ are compared with those reported for $BaTiO_3$. It is found that in all cases corresponding constants are of the same order of magnitude. A.

537.226.2 : 536.7

2067. A THERMODYNAMIC TREATMENT OF FERROELECTRICITY AND ANTIFERROELECTRICITY IN PSEUDO-CUBIC DIELECTRICS. L.E.Cross.

Phil. Mag. (Ser. 8), Vol. 1, 76-92 (Jan., 1956).

The Kittel-Devonshire phenomenological treatment of antiferroelectricity is extended to the case of polarizations in three dimensions in a pseudo-cubic material. There are ten possible solutions of the proposed free energy equation, corresponding to non-polar, ferroelectric, antiferroelectric and ferrielectric states, and expressions are derived for the polarization and dielectric stiffness coefficients in these forms. Using the experimental data for $NaNbO_3$, values of the constants in the free energy expression are derived which give satisfactory agreement with the observed phase changes, optical anisotropies and dielectric constants in this material. It is also shown that the major features of the phase diagram for $(NaK)NbO_3$ solid solutions are reproduced from the $NaNbO_3$ free energy expression if T_a, the antiferroelectric 'curie' temperature decreases linearly with increasing $KNbO_3$ concentration. These results are discussed in terms of the spatial relationships in the $NaNbO_3$ and $KNbO_3$ structures, and compared to the properties of the corresponding alkali tantalates. A.

537.226.3

2068. ON THE DIFFERENT ACTIVATION ENERGIES OF A DIELECTRIC. P.Caillon.
C.R. Acad. Sci. (Paris), Vol. 241, No. 18, 1200-2 (Oct. 31, 1955). In French.

The previous dielectric loss results (Abstr. 926/1955) indicate Debye dipolar orientation activation energies to be 120 kcal/mole for polyvinyl chloride and 55 kcal/mole for polyvinyl acetate, while the activation energies for Maxwell—Wagner type loss are 23 and 16 kcal/mole for the two polymers respectively. D.H.Whiffen

537.226.3

2069. DIELECTRIC ABSORPTION IN DILUTE, LIQUID, POLAR SOLUTIONS: A NEW APPROACH. A.Fairweather.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1038-42 (Dec., 1955).

Reconsideration of the behaviour of a macroscopic dipole on the lines initiated by Debye suggests that, for molecular dipoles, there may exist a mechanism, somewhat analogous to macroscopic turbulence, for which energy loss is related to density and not viscosity. In such circumstances the familiar Debye formula for the relaxation time would need to be replaced by $\tau \propto (a^5 \rho kT)^{1/2}$ (where a is the molecular radius, ρ density, k Boltzmann's constant, and T absolute temperature). This relation is consistent with the results of experiment in the microwave range. A.

537.226.3

2070. THEORY OF A DIELECTRIC LOSS IN LONG CHAIN POLAR COMPOUNDS. P.G.Harper and J.J.O'Dwyer.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1184-90 (Dec., 1955).

A new model is proposed which gives a dielectric absorption for long-chain polar compounds. Under the influence of an alternating applied field the equilibrium distribution of the dipoles is disturbed and it is supposed that a steady state is attained by each dipole interacting with its own molecular chain, the chains themselves always maintaining their equilibrium distribution. The frequency-dependent dielectric constant is found to be of the form $\epsilon(\omega) = \text{const.}(1 + i\omega\tau)^{-2}$ where τ is a collision time. The present theory does not preclude the co-existence of any of the other well-known types of dielectric absorption. A.

537.226.32

2071. EXPERIMENTS ON THE CARNAUBA WAX ELECTRET. R.Gerson and J.H.Rohrbaugh.
J. chem. Phys., Vol. 23, No. 12, 2381-8 (Dec., 1955).

The strength of the applied electric field, the thickness of the slab being electrified, the time of electrification and the low temperature holding time before removing the field were varied for carnauba wax electrets. After approximately one hour the discharge current varied inversely as a power of the time since turning off the forming field, the power being close to one. The magnitude of this current depended on both the forming field strength and on the thickness of the electret. A very large discharge was obtained when the wax was electrified and discharged while not completely solid. Dielectric constant measurements were made at temperatures between 27° C and 86° C, frequencies between 50 c/s and 13 kc/s, and with superposed d.c. field strengths in the wax of zero, 3700 and 8100 V per cm. The application of d.c. field was found to raise the dielectric constant at the higher temperatures. The case for permanent dipole orientation and that for ionic space charges as the cause of the stored charge of the electret is examined, and it is shown that there are objections to each mechanism. An alternate explanation is suggested. A.

ELECTRIC CONDUCTION. CURRENTS 537.3

537.31

2072. IONIC CONDUCTIVITY OF TANTALUM OXIDE AT VERY HIGH FIELDS. C.P.Bean, J.C.Fisher and D.A.Vermilyea.
Phys. Rev., Vol. 101, No. 2, 551-4 (Jan. 15, 1956).

The abnormally long jump distance λ which characterizes the ionic conduction of glasses as a function of electric field, $\sigma = \sigma_0 \exp(-q\lambda E/kT)$, and the fact that for tantalum oxide this distance changes by a factor of two at a critical field are explained in terms of a model in which ionic conduction is a two-stage process involving the creation and motion of interstitial metallic ions. Below a critical field both the number of interstitial ions and their mobility are rapidly varying functions of the field and the jump distance decreases discontinuously as the field increases. Above the critical field the number of interstitials depends much less strongly or not at all on the field, the field acts only to increase the ionic mobility, and the jump distance is of the order of the interatomic spacing. It is suggested that in tantalum oxide electrostatic repulsion between tantalum ions may provide the principle barrier to ionic motion. A.

537.311 : 537.312.7

2073. CONDUCTION OF MICRONIC AND SUB-MICRONIC SPHERICAL CONDUCTING PARTICLES IN AN INTENSE IONIZING ELECTRIC FIELD. R.Challande.
J. Rech. Cent. Nat. Rech. Sci., Vol. 6, 291-318 (Sept., 1955). In French.

A comprehensive treatment of the subject ranging from methods of production of particles, methods of observation, acquisition of charges, theory of precipitation in an electric field, discussion of experimental techniques and investigation to some applications of the phenomena to industrial processes. 50 refs. 6 pp. of plates. C.G.Morgan

537.311.1

2074. DETERMINATION OF THE MEAN FREE PATH OF THE CONDUCTION ELECTRONS IN POTASSIUM. R.Nossek.
Z. Phys., Vol. 142, No. 3, 321-33 (1955). In German.

Potassium layers were deposited on highly polished glass plates cooled to 90° K and their electrical resistance was measured as a function of film thickness, D. For D greater than 130 A the resistance behaves as expected on the basis of Chambers' (1950) theory of the mean free path. For the conduction electrons in K the mean free path is found to be 360 ± 20 A at 273° K. The exponential decrease in resistance with increasing film thickness in the range of D down to a monolayer is explained by supposing the layer to consist of grains between which the electrons move by tunnelling. The temperature coefficient of resistance is positive and lies between 2.5 and 6.0 x 10^{-3} per °C. C.A.Hogarth

537.311.31

2075. INFLUENCE OF INTER-ELECTRON COLLISIONS ON THE ELECTRICAL CONDUCTIVITY AND THE SKIN-EFFECT IN METALS. V.L.Ginzburg and V.P.Silin.
Zh. éksper. teor. Fiz., Vol. 29, No. 1 (7), 64-74 (1955). In Russian.

Bentham and Kronig's statement that the electron viscosity in metals, resulting from electron interaction, influences the absorptivity of metals for infrared radiation was investigated. This would be important in metal-optics, electrical and thermal conductivity, skin effect etc. It was found that the above authors' method is incorrect, and their results wrong. Except for very high frequencies, the effects of electron interaction are negligible.

Electrical Research Association

537.311.31

2076. ON THE STUDY OF THE ELECTRIC ANISOTROPY OF GALLIUM NEAR THE MELTING POINT. I.Epelboin and M.Erny.
C.R. Acad. Sci. (Paris), Vol. 241, No. 17, 1118-21 (Oct. 24, 1955). In French.

The strong anisotropy is reduced somewhat just below the melting point. C.A.Hogarth

537.311.31 : 541.183

2077. EFFECT OF SORBED WATER VAPOR UPON THE ELECTRICAL CONDUCTIVITY OF CONDITIONED CHROMIUM FILMS. J.M.Seehof and H.J.Trurnit.
J. chem. Phys., Vol. 23, No. 12, 2459-60 (Dec., 1955).

Films of chromium (0.002 to 0.05 mg/cm^2) were evaporated on to glass slides and their electrical resistance measured with a precision Wheatstone bridge. Under ordinary conditions the resistance increased irreversibly upon exposure to air or water vapour for periods of over one week. A slide with a film 0.0045 mg Cr/cm^2 was first placed for 2 hours in boiling distilled water and then dried and the resistance measured in a vacuum. The resistance increased when water vapour was admitted, by 1.4% at 6 mm, 2.0% at 12 mm and 3.0% at 18 mm Hg, but this process, however, is completely reversible. Admitting one atmosphere of dry air had no effect on the resistance of the conditioned film. J.Iball

537.311.32

2078. HIGH-RESISTIVITY NICKEL FERRITE — THE EFFECT OF MINOR ADDITIONS OF MANGANESE OR COBALT. L.G.Van Uitert.
J. chem. Phys., Vol. 24, No. 2, 306-10 (Feb., 1956).

Nickel ferrite, as ordinarily prepared, has a d.c. resistivity of 10^4 to 10^6 ohm-centimetre. It has been found that by incorporating small amounts of manganese or cobalt, the resistivities can be increased to 10^{10} or 10^{11} ohm-centimetre. Presumably, replacing Fe^{++} or Ni^{+++} with Mn or Co ions eliminates the easy conduction paths otherwise provided by the former ions. Further work is required to elucidate the exact mechanism. A.

537.311.33

2079. SEMICONDUCTOR CONVERTERS OF RADIANT ENERGY. V.S.Vavilov.
Uspekhi fiz. Nauk, Vol. 56, No. 1, 111-30 (1955). In Russian.

Survey article by a leading Soviet worker in this field. The paper covers such topics as electron–hole transitions in Ge and Si, transformation of β-radiation, equivalent circuits and efficiency of the above processes, sources of β-radiation, changes in the properties of a semiconductor under the action of fast electrons. 24 refs. C.R.S.Manders

537.311.33

2080. THEORY OF WELL-CONDUCTING SEMICONDUCTORS. I. EQUILIBRIUM OF THE ELECTRON GAS IN SEMICONDUCTORS. L.L.Korenblit and T.Ya.Shraĭfel'd.
Zh. tekh. Fiz., Vol. 25, No. 6, 1019-25 (1955). In Russian.

The characteristic of the "well-conducting", or metal-type semiconductors consists in their liability to change under certain conditions (i.e. at certain critical admixture concentrations, within certain temperature intervals, etc.) into the "quasi-metallic" state. Shifrin's theory of the degenerated state of the electron gas is supplemented by the authors in some important respects by a more rigorous consideration of the equilibrium state of the electron gas in semiconductors.

Electrical Research Association

537.311.33

2081. THEORY OF WELL-CONDUCTING SEMICONDUCTORS. II. ELECTRICAL CONDUCTIVITY. THERMO-E.M.F. HALL EFFECT. L.L.Korenblit and T.Ya.Shraĭfel'd.
Zh. tekh. Fiz., Vol. 25, No. 7, 1182-9 (1955). In Russian.

Temperature relation of the electrical conductivity, thermo-e.m.f. and Hall effect in degenerated semiconductors are considered. The calculation is simplified by considering only one of the possible causes of dispersion of the charge carriers, viz. lattice oscillations (phonons) and disregarding scatter of impurities on the atoms or ions. Methods of generalizing these results were previously given by Anselm and Klyachkin, but involve laborious calculations.

Electrical Research Association

537.311.33

2082. A METHOD OF MEASURING THE SURFACE RECOMBINATION VELOCITY OF SEMICONDUCTORS USING THE PHOTOMAGNETOELECTRIC EFFECT IN THE SINUSOIDAL REGIME. J.Grosvalet.
Ann. Radioélect., Vol. 10, 344-47 (Oct., 1955). In French.

The phase-angle ψ between the photomagnetoelectric voltage V_K and the photoresistive voltage V_R is expressed as $\psi = \phi + \phi_1$, where ϕ is the value of ψ for a thick specimen and ϕ_1 is the additional contribution due to surface recombination in a thin specimen. φ is given by $\tan 2\phi = \omega\tau$, where ω is the angular frequency of modulation of the light intensity and τ is the bulk lifetime of the semiconductor. An expression is derived for ϕ_1 in terms of the surface recombination velocity σ' on the non-illuminated surface and of the specimen thickness l. For any given l, τ and ω, a curve can be prepared for ψ against σ'. Apparatus for measuring ψ is illustrated and some values of σ' obtained by its use on germanium specimens with different surface treatments are tabulated.

F.F.Roberts

537.311.33

2083. THERMAL CONDUCTIVITY OF SEMICONDUCTORS. J.M.Thuillier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 17, 1121-2 (Oct. 24, 1955). In French.

By considering the flow of both electrons and holes it is shown that the charge carrier contribution to the thermal conductivity may be much larger than the corresponding value obtained by Lorentz for the free electron contribution. This result helps to explain the anomalous behaviour observed for the temperature variation of the thermal conductivity of InSb by Busch and Schneider. C.A.Hogarth

537.311.33

2084. AN EASY DERIVATION OF THE HOLE LIFETIME IN AN n-TYPE SEMICONDUCTOR WITH ACCEPTOR TRAPS. F.W.G.Rose and D.J.Sandiford.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 894-7 (Nov., 1955).

The recombination and generation processes for electrons and holes in an n-type semiconductor with acceptor traps are described when the concentrations of electrons and holes are much smaller than 10^{10} cm^{-3} at room temperature. With this assumption Boltzmann statistics and the mass-action laws apply. The relations between the constants of recombination, generation and the mass-action laws are described. These relations are used for the calculation of lifetime in the case of steady state injection. It is shown that instantaneous life-

time and steady state lifetime are different. Agreement with an equation by Shockley and Read is found. A.

537.311.33

2085. THE USE OF A MODULATED LIGHT SPOT IN SEMICONDUCTOR MEASUREMENTS. D.G.Avery and J.B.Gunn.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 918-21 (Nov., 1955).

A discussion is given of the modifications to the theory of the "travelling light spot" method for the measurement of minority carrier lifetime τ, which become necessary when the light spot is intensity modulated at an angular frequency. It is shown that if $\omega\sigma$ is much greater than 1, the "lifetime" measured is approximately $2/\omega$ and is independent of τ. It is also shown that, if the phase of the collector signal is measured as well as its amplitude, the diffusion constant and hence the drift mobility of minority carriers can be measured directly. A.

537.311.33

2086. THE INFRA-RED FARADAY EFFECT DUE TO FREE CARRIERS IN A SEMICONDUCTOR. E.W.J.Mitchell.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 973-4 (Nov., 1955).

It is shown how the effective mass of free electrons in a semiconductor may be derived from the infrared Faraday rotation. C.A.Hogarth

537.311.33

2087. MAGNETIC SUSCEPTIBILITY OF IMPURITY-TRAPPED ELECTRONS AND HOLES IN SEMICONDUCTORS. E.Mooser.
Phys. Rev., Vol. 100, No. 6, 1589-92 (Dec. 15, 1955).

According to the impurity content two cases can be distinguished. For sufficiently low impurity concentration, the interaction between the impurity centres can be neglected and the paramagnetic contribution of the trapped carriers to the susceptibility is of the Langevin type, i.e., inversely proportional to the temperature. The onset of interaction at higher concentrations, however, causes the impurity level associated with isolated impurities to broaden into a quasi-continuous energy band. The electrons or holes in such a band are free to move through the crystal and thus, forming a Fermi gas, give rise to a Pauli paramagnetism which at low temperatures is practically constant. In both cases the orbital diamagnetism is essentially the same and independent of temperature. The susceptibilities corresponding to the two cases are compared with one another and it is found that low-temperature susceptibility data should give valuable information on impurity bands. Measurements on Si are interpreted according to the present theory. A.

537.311.33

2088. INTERACTION OF IMPURITIES AND MOBILE CARRIERS IN SEMICONDUCTORS. G.W.Lehman and H.M.James.
Phys. Rev., Vol. 100, No. 6, 1698-712 (Dec. 15, 1955).

The interaction of mobile carriers in semiconductors with impurity atoms and ions tends to reduce the impurity activation energy. This effect is studied using the familiar model of the semiconductor as a uniform medium of dielectric constant K in which randomly distributed impurity ions appear as fixed unit charges and the mobile carriers as charges with opposite sign and effective mass m*. The treatment is based on the solution of Hartree equations for nonlocalized orbitals ψ_i describing mobile carriers and localized orbitals ϕ_i describing electrons trapped in the neighbourhood of impurity ions. Determination of the individual nonlocalized orbitals is made unnecessary by a method that expresses the fluctuation in mobile carrier density approximately as a linear functional of the fluctuations in electronic potential due to impurity atoms and ions. On use of this relation, Poisson's equation becomes a linear integro-differential equation for the electronic potential energy, which can be solved in terms of integrals involving the localized orbitals ϕ_i. All localized orbitals are taken to have the same form ϕ, satisfying an integro-differential equation obtained by averaging the potential energy for a trapped electron over all configurations of the other impurities; this is solved by a variational procedure. All orbitals in the theory depend on temperature T, the Fermi level ζ, and the impurity density N/V, since the distribution of quantum numbers of the occupied orbitals depends on these quantities. The free energy F of the system, first expressed in terms of the orbitals, T, and ζ, is then reduced to a function of ζ, T and N/V. For given T and N/V, the physically significant ζ is determined as that which minimizes F; the carrier density and the effective impurity activation energy are then computed as functions of T and N/V. The theory differs from all others in predicting a marked T-dependence of the activation energy, especially for high impurity concentrations. This appears because the polarizability of the mobile carrier distribution, which has an important effect on the interaction of impurities and mobile carriers, is temperature dependent in the present theory, and is completely ignored in earlier theories. For moderately high T the reduction in impurity activation energy predicted by the present theory is of the order of that predicted by Shifrin, and by Pearson and Bardeen; at low temperatures it is much less. Existing data on germanium and silicon suggest that the theory underestimates the reduction in activation energy at high impurity concentrations. A.

537.311.33

2089. IMPURITY SCATTERING IN SEMICONDUCTORS. R.Mansfield.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 76-82 (Jan., 1956).

The theory of impurity scattering in semiconductors is developed, and the combination of impurity and lattice scattering is considered for the general case of any degree of degeneracy of the charge carriers. A comparison is made between theory and experimental results obtained with germanium and indium antimonide. A.

537.311.33

2090. TRANSPORT AND DEFORMATION-POTENTIAL THEORY FOR MANY-VALLEY SEMICONDUCTORS WITH ANISOTROPIC SCATTERING. C.Herring and E.Vogt.
Phys. Rev., Vol. 101, No. 3, 944-61 (Feb. 1, 1956).

A transport theory which allows for anisotropy in the scattering processes is developed for semiconductors with multiple nondegenerate band edge points. It is found that the main effects of scattering on the distribution function over each ellipsoidal constant-energy surface can be described by a set of three relaxation times, one for each principal direction; these are the principal components of an energy-dependent relaxation-time tensor. This approximate solution can be used if all scattering processes either conserve energy or randomize velocities. Expressions for mobility, Hall effect, low- and high-field magnetoresistance, piezoresistance, and high-frequency dielectric constant are derived in terms of the relaxation-time tensor. For static-field transport properties the effect of anisotropic scattering is merely to weight each component of the effective-mass tensor, as it appears in the usual theory, with the reciprocal of the corresponding component of the relaxation-time tensor. The deformation-potential method of Bardeen and Shockley is generalized to include scattering by transverse as well as longitudinal acoustic modes. This generalized theory is used to calculate the acoustic contributions to the components of the relaxation-time tensor in terms of the effective masses, elastic constants, and a set of deformation-potential constants. For n silicon and n germanium, one of the two deformation-potential constants can be obtained from piezoresistance data. The other one can at present only be roughly estimated, e.g., from the anisotropy of magnetoresistance. Insertion of these constants into the theory yields a value for the acoustic mobility of n germanium which is in reasonable agreement with observation; a more accurate check of the theory may be possible when better input

data are available. For n silicon, available data do not suffice for a check of the theory. A.

537.311.33 : 535.39

2091. THE MEASUREMENT OF THE ENERGY GAP OF SEMICONDUCTORS FROM THEIR DIFFUSE REFLECTION SPECTRA. P.D.Fochs.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 70-5 (Jan., 1956).

The diffuse reflection spectrum of a powdered semiconductor is characterized by an increase in the diffuse reflectivity as the individual particles become relatively transparent. This increase has a definite linear region of greatest slope which is attributed to an exponential drop in the absorption coefficient. The onset of this exponential drop is suggested as a more universal method of determining absorption edges, and when applied to the interpretation of diffuse reflection spectra gave the following energy gaps (at room temperature): amorphous selenium 1.86 eV, metallic selenium 1.74 eV, silicon 1.20 eV, and germanium 0.69 eV. A.

537.311.33 : 537.312.5

2092. NEGATIVE PHOTOEFFECT IN SEMICONDUCTORS. F.Stöckmann.
Z. Phys., Vol. 143, No. 3, 348-56 (1955). In German.

Decrease in photoconductivity on illumination of some semiconductors is attributed to the optical release of minority carriers and their rapid recombination with majority carriers. G.F.J.Garlick

537.311.33 : 537.533.2

2093. THE EFFECT OF FIELD EMISSION ON THE BEHAVIOUR OF SEMICONDUCTOR CONTACTS. R.W.Sillars.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 881-93 (Nov., 1955).

If the potential applied across a contact between two conducting bodies exceeds one or two volts it is likely that the current flowing will be augmented by field emission around the area of intimate contact. This condition is analysed for conductors with no surface barrier, by treating the relation between surface field and emitted current density as a step-function and solving Laplace's equation with this boundary condition. With contacting bodies of normal shape it is found that the current will vary as the square or three-halves power of the applied voltage. Some experimental observations on semiconductors with negligible barrier effects are shown to be consistent with the predictions of this analysis. A similar analysis can be applied to metallic bodies which are not quite in contact, and shows that the emitted current is so concentrated as to cause melting of the metal even at very low currents. A.

537.311.33

2094. INFLUENCE OF THE HEAT TREATMENT ON THE CONCENTRATION AND MOBILITY OF CHARGE CARRIERS IN GERMANIUM. V.V.Ostroborodova and S.G.Kalashnikov.
Zh. tekh. Fiz., Vol. 25, No. 7, 1163-7 (1955). In Russian.

The influence of the hardening temperature on the concentration of the thermo-acceptors and on the mobility of electrons and holes in germanium is investigated. It is found that the mobility of the main and secondary charge carriers decreases strongly on approaching the range of transformation, this being interpreted by an increase of the inhomogeneities per unit volume in the crystal.

Electrical Research Association

537.311.33

2095. RECOMBINATION OF THE UNBALANCED CHARGE CARRIERS ON THE THERMAL ACCEPTOR IN GERMANIUM. V.V.Ostroborodova and S.G.Kalashnikov.
Zh. tekh. Fiz., Vol. 25, No. 7, 1168-74 (1955). In Russian.

The influence of thermal treatment on the rate of volume recombination of electrons and holes in germanium shows that thermal acceptors strongly reduce the life of the unbalanced charge carriers. Under the given experimental conditions the life varied in inverse proportion to the concentration of the thermal acceptors. The effective cross-section of recombination of the thermal acceptors was found to be 2.5×10^{-17} cm. The recombination cross-sections for different admixtures may differ considerably. Electrical Research Association

537.311.33

2096. THE TURNOVER PHENOMENON IN THERMISTORS AND IN POINT-CONTACT GERMANIUM RECTIFIERS. R.E.Burgess.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 908-17 (Nov., 1955).

Thermistors are semiconducting devices which display a voltage maximum in their steady-state current characteristics. The properties of this "turnover" phenomenon can be calculated from the dependence of the thermistor conductance on the temperature of the element and for an exponential relation of the form $I \propto V \exp(-b/T)$ it is found that the turnover power increases as the square of the absolute ambient temperature. The similarity in form between the reverse characteristic of a point-contact germanium rectifier and the static characteristic of a thermistor suggests a thermal hypothesis for rectifier turnover. However, in the latter, the turnover power decreases approximately linearly with the ambient temperature. Even if it be assumed that the isothermal characteristic is not linear and that the energy term b is a function of applied voltage such as would be expected in a number of physical models, the theoretical turnover power increases with increasing ambient temperature. A number of possible forms for the dependence of rectifier current on the voltage and contact temperature are examined and a general type of function which displays the essential features of the observed turnover behaviour is discussed. The physical basis for such a dependence does not conform with existing theories of rectification and a radical revision of these is apparently required under the conditions of elevated contact temperature and high field which exist at turnover. A.

537.311.33

2097. THE INFLUENCE OF PRESSURE ON METAL–GERMANIUM CONTACTS. J.Lees and S.Walton.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 922-8 (Nov., 1955).

The dependence of the electrical properties of the germanium immediately below a point contact on the stress existing in this region is investigated. Electrical and optical methods of measuring the area of these contacts gave different results. This anomaly is shown to arise from the variation of the resistance of the germanium with pressure. A.

537.311.33

2098. STATISTICS AND GALVANOMAGNETIC EFFECTS IN GERMANIUM AND SILICON WITH WARPED ENERGY SURFACES. B.Lax and J.G.Mavroides.
Phys. Rev., Vol. 100, No. 6, 1650-7 (Dec. 15, 1955).

A method is developed for calculating the statistical properties and galvanomagnetic effects of p-type Ge and Si for weak magnetic fields. The calculations involving the use of the Boltzmann transport theory are applied to the warped energy surfaces which have been determined by the cyclotron resonance experiments. Expressions are developed for the hole densities, conductivity, effective masses, intrinsic carrier concentration and Hall coefficient as a series expansion in terms of the anisotropy parameters of the warped surfaces. Results have been obtained for the assumption that the relaxation time $\tau = l\epsilon^{-\lambda}$, where l is a constant, ϵ is the energy of the carriers and is a parameter whose numerical value depends on the scattering processes. By using the results of the calculations and existing experimental data, a speculation is made concerning the possible change with temperature of the combined effective mass of holes in germanium and the corresponding change in the band structure. A.

537.311.33

2099. THERMAL ACCEPTORS IN VACUUM HEAT-TREAT-

ED GERMANIUM. R.L.Hopkins and E.N.Clarke.
Phys. Rev., Vol. 100, No. 6, 1786-7 (Dec. 15, 1955).

If great care is taken with surface cleaning processes, few thermal acceptors are introduced into germanium by rapid quenching from about 900° C. C.A.Hogarth

537.311.33

2100. DEFORMATION POTENTIAL THEORY FOR N-TYPE Ge. W.P.Dumke.
Phys. Rev., Vol. 101, No. 2, 531-6 (Jan. 15, 1956).

The deformation potential theory has been re-examined for electrons in Ge to take into account the ellipsoidal nature of the energy surfaces, and the effect of shear wave scattering. The coupling between shears and the conduction band energy minima is calculated from Smith's piezoresistance data under the assumption that any changes in mobility due to strain may be neglected. The scattering by shears, which is the dominant mechanism, is strongly anisotropic and cannot be described by a simple relaxation time. It is shown that the distribution function for electrical conductivity has a tensor dependence on the orientation of the electric field. The mobility is calculated assuming several values of E_{1C}, the shift of the conduction band edge with dilation. The calculated values of the mobility are approximately $3 \times 10^7 T^{-3/2}$ cm^2/V.sec. Methods of accounting for discrepancies between the experimental and theoretical values of the mobility and its temperature dependence are discussed. A.

537.311.33

2101. INFRARED ABSORPTION IN n-TYPE GERMANIUM. H.Y.Fan, W.Spitzer and R.J.Collins.
Phys. Rev., Vol. 101, No. 2, 566-72 (Jan. 15, 1956).

Theory of absorption by free carriers is given taking into account the effects of scattering by impurities and by lattice vibrations. Experimental results are reported for n-type germanium samples of various carrier and impurity concentrations. The measurements were made in the temperature range between 78° K and 450° K, covering a wavelength region from 5 to 38 microns. At the high temperature end, the absorption is proportional to the carrier concentration, lattice scattering being the dominant effect. At 78° K, the absorption per unit carrier concentration consists of a constant part and a part proportional to the impurity concentration. The absorption increases with wavelength more rapidly at the low temperature. The frequency and temperature dependences of absorption in the various samples are in good agreement with the theory. Quantitative agreement can be obtained by using an effective mass $m^* \simeq 0.1m$. A.

537.311.33

2102. HALL EFFECT IN ORIENTED SINGLE CRYSTALS OF n-TYPE GERMANIUM. W.M.Bullis and W.E.Krag.
Phys. Rev., Vol. 101, No. 2, 580-4 (Jan. 15, 1956).

Hall measurements have been made on oriented single crystals of n-type germanium confirming the variations of the Hall coefficient with the direction and magnitude of the magnetic field, and with the direction of the current, which are predicted by theories based on the eight-ellipsoid model. Although other assumptions must be made to secure exact agreement, these measurements, when made under suitable conditions, can be explained by a theory assuming an energy-independent scattering time τ. This type of measurement may be useful in determining asymmetry properties of the energy surfaces near a band edge in other semiconductors. A.

537.311.33

2103. EFFECT OF ELECTRIC FIELD ON SURFACE RECOMBINATION VELOCITY IN GERMANIUM. J.E.Thomas, Jr and R.H.Rediker.
Phys. Rev., Vol. 101, No. 3, 984-7 (Feb. 1, 1956).

The surface recombination velocity of n-type germanium is found to vary when an electric field is applied normal to the surface of the material. The results are sensitive to the atmosphere around the germanium. The theoretical predictions of the relation between surface recombination velocity and surface potential are qualitatively confirmed by these experiments. In addition, further evidence in favour of the surface-trap explanations for semiconductor excess noise now is found. A.

537.311.33

2104. REVIEW OF GERMANIUM SURFACE PHENOMENA. R.H.Kingston.
J. appl. Phys., Vol. 27, No. 2, 101-14 (Feb., 1956).

Germanium surface behaviour has become of great interest, chiefly for its importance in the understanding of diode and transistor technology. In general, the surface may be treated as an assemblage of allowed electron states occurring in the normally forbidden energy range. A review of the measurements of the electrical properties suggests that there are two distinct types of state. The "fast" state has a hole or electron capture time not greater than a microsecond and is chiefly involved in the recombination process. The "slow" state has capture times from a millisecond to several minutes and determines the density and type of carrier at the surface. "Fast" states are believed to occur at the interface between the germanium and the oxide layer, and their density of about 10^{11} cm^{-2} is determined by the initial surface treatment. "Slow" states are associated with the structure of the oxide layer and the gaseous ambient, and have a density greater than 10^{13} cm^{-2}. Since these states determine the conductivity type at the surface, they contribute to surface "leakage" in diodes and transistors and, because of their long equilibrium times, to low-frequency noise. The adsorption of gases such as water vapour, not only controls the density and energy of the "slow" states but also leads to possible electrolytic conduction along the surface, in addition to the normal electron flow in the bulk semiconductor. A.

537.311.33 : 537.572

2105. ON IMPACT IONIZATION IN SILICON AND GERMANIUM. E.Groschwitz.
Z. Phys., Vol. 143, No. 5, 632-6 (1956). In German.

The ionization coefficient α is calculated for large and small values of the electric field strength, following conventional gas ionization theory. Fair agreement is obtained with the experimental data of McKay and McAfee (Abstr. 458/1954). C.A.Hogarth

537.311.33

2106. OPTICAL ABSORPTION EDGE AND EFFECTIVE MASS OF ELECTRONS IN INDIUM ANTIMONIDE. P.Aigrain and J.des Cloizeaux.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 849-62 (Oct. 3, 1955). In French.

Further analysis of effect of electrons in postulated E,k diagrams for InSb, as suggested by Burstein. The screening effect of the electrons is estimated and it is found that the optical effective mass is equal to three times the normal electron effective mass. C.A.Hogarth

537.311.33

2107. THE LIFETIME OF ADDED CARRIERS IN InSb. I.M.Mackintosh and J.W.Allen.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 985-90 (Dec., 1955).

The Roosbroeck–Shockley theory of radiative recombination of electrons and holes in semiconductors is extended to the case of degenerate semiconductors and applied in InSb. The experimental optical absorption curves of various n-type and p-type samples are analysed and results given for the lifetime of added carriers for this process alone as a function of the position of the Fermi level. An extrapolation indicates a decay time for a small disturbance in carrier concentration in intrinsic material of 0.75 microsec. Comparison with experimental results indicates that this process may be predominant in InSb. A.

537.311.33

2108. HALL EFFECT AND CONDUCTIVITY OF InSb. H.J.Hrostowski, F.J.Morin, T.H.Geballe and G.H.Wheatley. Phys. Rev., Vol. 100, No. 6, 1672-6 (Dec. 15, 1955).

Hall coefficient and conductivity of single-crystal InSb have been measured from 1.3°K to 700°K. Impurity band conduction and an acceptor ionization energy of 7×10^{-3} eV have been observed in p-type InSb at low temperature. Variation of R_H with H indicates a complicated valence band structure. Effective masses of 0.015 m for electrons and approximately 0.17 m for holes are consistent with mobility and low temperature Hall effect data. Lattice scattering mobilities are proportional to $T^{-1.68}$ for electrons and approximately $T^{-2.1}$ for holes. The intrinsic carrier concentration product is given by $np = 3.6 \times 10^{29} T^3 \exp(-0.26/kT)$ above 200°K. E_g at 0°K is between 0.26 and 0.29 eV. A.

537.311.33

2109. INFRARED ABSORPTION OF INDIUM ANTIMONIDE. E.Blount, J.Callaway, M.Cohen, W.Dumke and J.Phillips. Phys. Rev., Vol. 101, No. 2, 563-4 (Jan. 15, 1956).

Infrared absorption in InSb near the absorption edge has been interpreted as the superposition of two indirect transitions requiring phonons of 100° and 30°, the former transition involving the smaller electronic energy gap. The first transition is consistent with a band scheme having electrons at the centre of the zone and holes either at the corner of the zone or about halfway along the [1, 1, 1] line. The other transition may indicate a second hole with an energy gap about 0.025 eV larger than that of the first. A.

537.311.33

2110. MEASUREMENTS OF CURRENT NOISE IN LEAD SULPHIDE AT AUDIO FREQUENCIES. D.Barber. Proc. Phys. Soc. B, Vol. 68, Pt 11, 898-907 (Nov., 1955).

Measurements have been made of the electrical noise produced by passing direct current through lead sulphide photoconductive cells. The mean square noise voltage per unit bandwidth, $\overline{v_n^2}$, was measured in relation to frequency, mean exciting current, cell temperature, and illumination. $\overline{v_n^2}$ was found to vary as the square of the exciting current and to increase with decreasing frequency in a manner which varied from cell to cell. $\overline{v_n^2}$ also increased as the resistance was increased, either by altering the temperature or the illumination, and was dependent on the temperature and illumination only in so far as they affected the resistance. A.

537.311.33

2111. EXCHANGE EFFECTS IN SPIN RESONANCE OF IMPURITY ATOMS IN SILICON. G.Feher, R.C.Fletcher and E.A.Gere. Phys. Rev., Vol. 100, No. 6, 1784-6 (Dec. 15; 1955).

The satellite lines observed in the microwave resonance of donors in silicon were explained by Slichter as being due to the exchange coupling between two electrons. Additional lines attributable to an exchange between 2, 3 and 4 electrons are reported here from measurements on phosphorous-doped Si samples, measured at 9000 Mc/s and at 1.2°K. C.A.Hogarth

537.312 : 537.224 : 541.183

2112. SOME ELECTRICAL EFFECTS OF THE ADSORPTION OF WATER VAPOUR BY ANODIZED ALUMINIUM. A.C.Jason and J.L.Wood. Proc. Phys. Soc. B, Vol. 68, Pt 12, 1105-16 (Dec., 1955).

The equivalent parallel capacity C_p and resistance R_p measured between the aluminium base of an anodically formed oxide film and a porous conducting layer deposited on the exposed surface of the oxide vary considerably with relative humidity p. At low frequencies porous oxide films show a range of variations of C_p of the order of 1 to 100, increasing with p, and the corresponding range of variation of R_p is of the order of 1000 to 1. Non-porous oxide films show very much smaller variations. Both C_p and R_p decrease with increasing frequency f for porous films. These observations have been related to an equivalent circuit based on the physical structure of the porous film. It is assumed that the principal effect of increasing relative humidity is to decrease the resistance dow the length of the pore sides. A quantitative comparison confirms that this accounts both for the very large variations of C_p and R_p with p and for their variation with f. A.

537.312.5

2113. PHOTOVOLTAIC EFFECT IN CRYSTALLINE CADMIUM SULPHIDE. G.Nadzhakov and R.Andreĭchin. Izv. Bulg. Akad. Nauk , Vol. 4, 3-10 (1954; publ. 1955). In Bulgarian. Shorter version in French in C.R. Acad. Bulg. Sci., Vol. 7, No. 2, 13-16 (April-June, July-Sept., 1954).

Preliminary studies of the effect are made using a crystal with electrodes selected from the metals Al, Zn, Fe, Cu and Pt. The e.m.f. (from 0.1 to 0.6 eV) produced by illumination always depends on the contact potential difference between the electrodes and on the intensity and spectral composition of the illumination. See also abstract following. G.F.J.Garlick

537.312.5

2114. PHOTOVOLTAIC EFFECT IN EVAPORATED CADMIUM SULPHIDE TRANSVERSELY ILLUMINATED. G.Nadzhakov, R.Andreĭchin and M.Borisov. Izv. Bulg. Akad. Nauk, Vol. 4, 11-15 (1954; publ. 1955). In Bulgarian. Shorter version in French in C.R. Acad. Bulg. Sci., Vol. 7, 17-20 (April-June, July-Sept., 1954).

A layer of CdS is evaporated on to an insulating support with two electrodes of different metals superposed on the layer by evaporation. On illumination a photo-e.m.f. is exhibited which depends on the contact potential difference between the electrodes and on the intensity and spectral composition of the illumination. See also preceding abstract. G.F.J.Garlick

537.312.5

2115. NEGATIVE INNER PHOTOEFFECT IN ZINC OXIDE. M.Borisov and S.Kŭnev. Izv. Bulg. Akad. Nauk, Vol. 4, 17-45 (1954; publ. 1955). In Bulgarian with summary (1 p.) in German. Shorter version in Russian in C.R. Akad. Bulg. Sci., Vol. 7, No. 2, 21-8 (April-June, July-Sept., 1954).

By using a radiofrequency dielectric loss method the photoconductivity of a powder-form sample of zinc oxide is measured. At higher temperatures the normal increase in conductivity on illumination changes to a decrease. Collisions of excitons with non-ionized zinc atoms in solid solution causes the positive photocurrent and green luminescence. Collisions with thermally ionized zinc atoms are assumed to explain the negative photoconduction effect. G.F.J.Garlick

537.312.5

2116. ON THE PHOTOCONDUCTIVITY OF STILBENE. G.Drefahl and H.J.Henkel. Naturwissenschaften, Vol. 42, No. 23, 624 (1955). In German.

Stilbene shows photoconductivity of the same order of magnitude as in anthracene. Trans-α-methyl stilbene shows no effect. Dependence of photocurrent on crystal orientation relative to applied field direction is studied. G.F.J.Garlick

537.312.5

2117. ON THE PROBLEM OF THE PHOTOEFFECT IN LEAD SULPHIDE AND RELATED SUBSTANCES. R.Stein and B.Reuter. Z. Naturforsch., Vol. 10a, No. 8, 655-6 (Aug., 1955). In German.

It is shown that in oxygen-sensitized photoconducting cells of lead sulphide the following are found to be significant, (i) influence of excess sulphur , (ii) influence of oxygen, giving initially PbO + S_2, (iii) reaction of PbO and S_2 which leads to fast infrared response at room temperature, (iv)

oxygen in the PbO leading to visible response at room temperature. See also abstract following. G.F.J.Garlick

537.312.5

2118. ON THE PROBLEM OF THE PHOTOEFFECT IN LEAD SULPHIDE AND RELATED SUBSTANCES. II. R.Stein and B.Reuter.
Z. Naturforsch., Vol. 10a, No. 11, 894-6 (1955). In German.

See preceding abstract. The photosensitization and chemical sensitization in PbS cells by excess sulphur are assumed to be associated with PbS_2 formation. Analogous conditions exist in sensitization of PbO with O_2. Intermediate cases of PbS–PbO are also discussed and an explanation offered of the dependence of spectral response on constitution and temperature. G.F.J.Garlick

537.312.5

2119. QUANTUM YIELD OF A CADMIUM SULFIDE PHOTOVOLTAIC CELL. R.E.Marburger, D.C.Reynolds, L.L.Antes and R.S.Hogan.
J. chem. Phys., Vol.23, No. 12, 2448-9 (Dec., 1955).

A graph of quantum yield v. wavelength for the range 0.5 to 0.95 microns is given. This was obtained by measuring the short-circuit current produced in a CdS cell by monochromatic radiation of measured intensity, and then inserting the values obtained in an equation derived by Lehovec (Abstr. 3769/1948). J.Dutton

537.312.5

2120. ANGULAR DISTRIBUTION OF PHOTOELECTRONS. R.R.Roy, M.L.Goes and J.Berger.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1936-8 (Dec. 19, 1955). In French.

The angular distributions of photoelectrons ejected from Al by the 1.17 and 1.33 MeV γ-rays of Co^{60} have been measured with a cloud chamber. The distributions appear to fall of off more rapidly at large angles ($> 20^0$) than is expected theoretically. J.J.Wilkins

537.312.5 : 538.639

2121. PHOTOELECTROMAGNETIC EFFECT IN INSULATING CdS. H.S.Sommers, Jr, R.E.Berry and I.Sochard.
Phys. Rev., Vol. 101, No. 3, 987-8 (Feb. 1, 1956).

The short-circuit photoelectromagnetic current was measured in a batch of electroluminescent crystals. The product $(\text{mobility})^3 \times (\text{lifetime})$ is found to be 1 $cm^6/volt^3\ sec^2$. The sensitivity of the equipment was sufficient to detect the photoelectromagnetic effect for crystals having a product as low as 10^{-5} $cm^6/volt^3\ sec^2$. A.

537.312.62

2122. EFFECTS OF ELASTIC DEFORMATIONS ON SUPERCONDUCTIVITY. II. THE CASE OF MERCURY. C.Grenier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 862-5 (Oct. 3, 1955). In French.

The effect of axial stress on the critical magnetic field has been measured for single crystals of Hg: the anisotropy of the effect varies markedly with temperature, whereas in Sn it did not (see Pt I, Abstr. 7978/1955). It is concluded that in Hg, though not in Sn, stress alters the electronic specific heat as well as the vibrational properties of the lattice. R.G.Chambers

537.312.62

2123. SOME CONSEQUENCES OF THE EFFECTS OF ELASTIC DEFORMATION ON SUPERCONDUCTIVITY: MAGNETOSTRICTION. C.Grenier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1275-7 (Nov. 7, 1955). In French.

From the change in critical field with stress (preceding abstract), values are deduced for the change in dimensions of Sn and Hg when the field passes through the critical value. R.G.Chambers

537.312.62

2124. EFFECT OF PRESSURE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF THALLIUM. J.Hatton.
Phys. Rev., Vol. 100, No. 6, 1784 (Dec. 15, 1955).

Resistance measurements show that T_c rises from 2.374^0K at 274 kg/cm^2 to a max. of 2.380^0K at about 1400 kg/cm^2, and then falls to 2.368^0K at 4733 kg/cm^2 (the highest pressure used). This explains the disagreement between previous observations. Transition widths were about 0.01^0K. R.G.Chambers

537.312.62

2125. STRUCTURE OF THE INTERMEDIATE STATE IN SUPERCONDUCTORS. A.L.Schawlow.
Phys. Rev., Vol. 101, No. 2, 573-9 (Jan. 15, 1956).

A niobium powder method has been used to display the arrangement of normal and superconducting domains in the intermediate state of a superconductor. Patterns have been observed on samples of tin, indium, lead, vanadium and tantalum, and have been studied in some detail for tin. It has been found possible to produce patterns which are plane parallel lamina in a flat plate. From their spacing the surface energy at a superconducting–normal interface was evaluated. For tin, the surface-energy parameter, Δ, is of the order of 3×10^{-5} cm. Both the magnitude of Δ and its variation with temperature are consistent with theories of its origin advanced by Ginsburg and Landau, Bardeen and Lewis. Similar results were obtained for indium and lead, but hard superconductors like tantalum, and especially vanadium, give coarser patterns, indicating a very much larger surface energy. A.

537.312.62

2126. SUPERCONDUCTIVITY AND ELECTRONIC SPECIFIC HEAT. H.W.Lewis.
Phys. Rev., Vol. 101, No. 3, 939 (Feb. 1, 1956).

An empirical correlation between critical field and critical temperature of a class of superconducting elements and intermetallic compounds is described. It is shown that for all those which do not have a partly filled d or f shell, H_0 is of the order of $T_c^{1.37}$. This implies a similar relation involving the electronic specific heat parameter γ Some further implications are discussed. A.

537.312.62 : 534.23

ABSORPTION OF 10 Mc/s SOUND WAVES IN A SUPERCONDUCTING TIN ROD. See Abstr. 1001

537.312.9

2127. ELECTRICAL RESISTIVITY TENSOR FOR ALUMINUM SINGLE CRYSTALS DEFORMED AT HELIUM TEMPERATURE. A. Sosin and J.S.Koehler.
Phys. Rev., Vol. 101, No. 3, 972-7 (Feb. 1, 1956).

Stress–strain curves and electrical resistance measurements were made on single crystals of 99.99+% pure aluminium pulled in tension at 4^0K. The stress–strain data show that beyond the easy-glide region the stress–strain curves are linear with a slope that depends on crystal orientation. If the specimen is unloaded and aged at room temperature, a small upper yield point occurs on reloading at 78^0K or 4^0K. The resistance produced by deformation is the same in all crystallographic directions. It increases as the square of the resolved shearing stress. Annealing at 78^0K produces a 10% drop in the strain-induced resistivity (which is still isotropic). Annealing at 300^0K produces a 65% drop in the strain-induced resistivity (again isotropic). A.

537.322 : 536.7

2128. THERMOELECTRIC EFFECT IN SOLUTIONS OF ELECTROLYTES. II. CALCULATION OF THE ABSOLUTE TRANSPORT ENTROPIES. G.Leman and G.Lepoutre.
J. Chim. phys., Vol. 52, No. 10, 765-70 (1955). In French.

The authors use the results obtained in Pt I (Abstr. 9674/

1955) and apply the method of Temkin and Khorosin (Zhurnal Fizicheskoĭ Khimiĭ, Vol. 26, 500, 1952) to determine the absolute values of entropies of electron transport in metals. A method is demonstrated of deducing the absolute entropies of the transport of ions in aqueous solutions from the thermoelectric force of thermocouples. Preliminary results are given, and the effect of solvation is demonstrated.

F.Lachman

537.323 : 548.7

2129. EFFECT OF POINT IMPERFECTIONS ON THE ELECTRICAL PROPERTIES OF COPPER. II. THERMOELECTRIC POWER. F.J.Blatt.
Phys. Rev., Vol. 100, No. 2, 666-70 (Oct. 15, 1955).

For Pt I, see Abstr. 321 (1956). The changes in the thermoelectric power of copper due to the presence of interstitials and vacancies have been calculated in the free-electron approximation. It is found that the changes for concentrations of defects encountered in experiments on radiation damage due to massive charged particles are, at liquid nitrogen temperature, of the same magnitude as the absolute thermoelectric power of pure copper. Both interstitials and vacancies tend to reduce the absolute thermoelectric power of copper, and this effect should be readily observable in a suitably designed experiment. It is suggested that the effect may also be used to throw additional light on the processes which occur in the annealing of an irradiated sample. The calculated changes in the thermoelectric property of copper due to Frenkel defects are also of such magnitude as to make adequate precautionary measures necessary whenever the thermo-couple, which is used to measure the temperature of the specimen, is also in the beam of the massive charged particles. Unless the thermocouple is suitably screened from the beam, unreliable temperature measurement is likely to result. Curves showing the predicted temperature and concentration dependence of the thermoelectric power change due to Frenkel defects are presented. The effect of small concentrations of arsenic in solid solution in copper on the thermoelectric power of copper has has also been calculated by the same procedure. The calculated results are in satisfactory agreement with experiment, indicating that the results for interstitials and vacancies are probably of the correct magnitude. A.

ELECTRIC DISCHARGES 537.52

537.523.3

2130. SOME APPLICATIONS OF THE METHODS OF SIMILITUDE AND DIMENSIONS IN THE THEORY OF THE D.C. CORONA DISCHARGE. N.N.Tikhodeev.
Zh. tekh. Fiz., Vol. 25, No. 7, 1257-64 (1955). In Russian.

The corona phenomena belongs to those physical problems of composite character to which a direct theoretical approach has not yet been found, although the experimental data collected represent an impressive body of observations. Author shows that the method of similitude and dimensions are the most suitable means of correlating the available observations, provided the hypothetical mechanism of the phenomenon on which their application must be based bears some relation to physical facts. Electrical Research Association

537.523.3

2131. DIFFERENTIAL EQUATION OF UNIPOLAR CORONA AND ITS INTEGRATION IN THE SIMPLEST CASES. N.N.Tikhodeev.
Zh. tekh. Fiz., Vol. 25, No. 8, 1449-57 (1955). In Russian.

The theory of the corona discharge cannot catch up with the empirical knowledge of the phenomena because of the non-linear character of the fundamental differential equations. The author discusses the inconclusive contributions of Townsend, Deutsch, Popkov and Mayr which refer only to severely restricted ranges, and have to rely on artificial assumptions, and presents a full solution of the three simplest problems of corona theory, based on the continuity equation of the ion current. Electrical Research Association

537.523.4

2132. INVESTIGATION OF THE LUMINOUS PHENOMENA ASSOCIATED WITH THE DEVELOPMENT OF THE CHANNEL OF THE SPARK DISCHARGE.
M.P.Vanyukov, V.I.Isaenko and L.D.Khazov.
Zh.tekh. Fiz., Vol. 25, No. 7, 1248-56 (1955). In Russian.

The space-time development of the luminescence of the channel of a spark discharge in the visible and infrared spectral range was investigated by means of an electron-optical transducer, and also the propagation of the shock wave set up by the discharge. The channel itself is surrounded by a gas layer emitting infrared radiation, viz. mainly the arc spectrum lines of the gas. The spectral energy density of the argon and xenon discharge was measured.

Electrical Research Association

537.523.5

2133. SIGNIFICANCE OF ELECTRODE EMISSION PROCESSES IN THE CONTRACTIONS THEORY. G.Ecker.
Z. Phys., Vol. 142, No. 4, 447-62 (1955). In German.

A continuation of previous work (Abstr. 8879/1952, 6815/1953, 3513, 5645/1954) in which account of electron emission processes is taken. A brief review of the general conceptions of the contractions theory is also given.

C.G.Morgan

537.523.5

2134. ANODE AND CATHODE ARCS. L.H.Germer and W.S.Boyle.
Nature (London), Vol. 176, 1019 (Nov. 26, 1955).

Describes briefly how short arcs, i.e. those less than 1 micron in length may be classified into anode and cathode arcs by the electrode marks. Two photographs of cathode marks are shown. See also abstract following. J.D.Craggs

537.523.5

2135. TWO DISTINCT TYPES OF SHORT ARCS.
L.H.Germer and W.S.Boyle.
J. appl. Phys., Vol. 27, No. 1, 32-9 (Jan., 1956).

Short field emission arcs are of two types, those which vaporize metal predominantly from the anode by electron bombardment, and those in which the metal of the arc is supplied from the cathode largely by the melting of points by the field emission currents flowing through them. These are appropriately called "anode arcs" and "cathode arcs". A single anode arc erodes a pit in the anode and leaves a corresponding roughened area on the cathode. A single cathode arc, on the other hand, leaves on the cathode a widely dispersed array of individual pits which tend strongly to lie along scratch lines; in many cases no mark at all can be found on the anode after an arc of this type. Anode and cathode arcs differ in arc voltage, which is higher for cathode arcs than for anode arcs, and in other ways. Both types of arcs have been observed for many metals but the data reported here are for palladium only. For clean surfaces of palladium all arcs are of the cathode type at a striking potential of 400 volts, but at 300 volts and at lower voltages anode arcs are observed also, becoming more frequent as the voltage is lowered. For surfaces activated by carbonaceous material only arcs of the cathode type occur at all striking potentials. In an anode arc, metal is transferred in both directions, as measured by radioactive tracers, but the net transfer is from anode to cathode. A cathode arc transfers metal from cathode to anode only, and the magnitude per unit of arc energy is less than the transfer in an anode arc. A.

537.523.5

2136. ANODE TEMPERATURES AND CHARACTERISTICS OF THE D.C. ARC IN NOBLE GASES. B.L.Vallee and

M.R.Baker.
J. Opt. Soc. Amer., Vol. 46, No. 2, 77-82 (Feb., 1956).

The construction of a gas-tight arcing chamber and continuously recording optical pyrometer is described. The system is reproducible. The current and voltage of the d.c. carbon arc in noble gases show a sensitive and systematic dependence on the atmospheres employed. A small admixture of a foreign gas, such as air, markedly alters the characteristics of the arc. The arc voltage for fixed current decreases in the order He, Ne, A, and Kr. Thus, the power input decreases in the same order. The anode temperature is linearly related to the power input. The behaviour of the cross-sections of the gases to electrons in the energy range of the Ramsauer—Townsend effect is suggested as a major contributor to the observed behaviour of the d.c. arc in noble gases. A.

537.523.5

2137. EFFECT OF ALKALI AND ALKALINE EARTH CHLORIDES ON THE ANODE TEMPERATURE OF THE D.C. ARC. B.L.Vallee and R.E.Thiers.
J. Opt. Soc. Amer., Vol. 46, No. 2, 83-6 (Feb., 1956).

Temperatures of graphite anodes have been measured for the d.c. arc in helium and argon by means of a recording thermistor pyrometer when pure chlorides of the alkali and alkaline earth metals are present as samples. Anode temperatures and gap voltages were depressed by all of the samples. The data for helium indicate a correlation of anode temperature to the boiling point of the sample salt and the lowest excitation potential of the cation. Correlation was also observed between the boiling point of the salt and its rate of volatilization. Temperatures in argon are lower and correlation between anode temperatures and either boiling points or excitation potentials was not observed. However, rates of volatilization were related to the boiling points and excitation potentials of the samples. These effects are large enough to account for the poor precision of the d.c. arc as a spectrochemical source and show the physical-chemical basis for the use of "spectroscopic buffers". A.

537.523.5

2138. GLOW-TO-ARC TRANSITION. W.S.Boyle and F.E.Haworth.
Phys. Rev., Vol. 101, No. 3, 935-8 (Feb. 1, 1956).

The conditions for the glow-to-arc transition at moderately high pressures (50 to 1300 mm Hg) have been studied experimentally. It is found that over the whole pressure range the transition is certain when the field at the cathode reaches a critical value. This result is shown to be consistent with a field emission mechanism for the transition. Calculations of the critical field based on this process are found to be in good agreement with the fields which are determined experimentally. A.

537.525.4

2139. THE BREAKDOWN OF GASES SUBJECT TO CROSSED ELECTRIC FIELDS. W.A.Prowse and P.E.Lane.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 33-46 (Jan., 1956).

The hypothesis is made that in ultra-high-frequency breakdown where the drift movement imposed on an electron by the field is very restricted, the localization of the electron contributes to breakdown. An experimental system is described in which an auxiliary unidirectional or relatively low-frequency field is imposed at right angles to a microwave field to destroy the localization. When the auxiliary field is unidirectional, or of relatively low frequency (0.86 Mc/s) its application raises the breakdown stress, but when the frequency is raised to 9.7 Mc/s the two fields appear to act quite independently in producing breakdown. A partial explanation is advanced. The gases studied include air, oxygen, nitrogen, hydrogen and neon. A.

537.525.8

2140. THE PRODUCTION OF METALLIC NITRIDES IN GLOW DISCHARGES, AND DATA ON THEIR PROPERTIES. W.Janeff.
Z. Phys., Vol. 142, No. 5, 619-36 (1955). In German.

The nitrides of 10 metals were prepared in glow discharges in nitrogen, using cathodes containing the respective metals. Molecular compositions were checked appropriately, and studies of their electrical conductivities were made with thin nitride layers deposited on glass plates. Temperature coefficients of resistance were also measured. Further tests for photoemission were made, but none was detected.
J.D.Craggs

537.525.8

2141. SCREENED PROBE MEASUREMENTS IN THE HELIUM NEGATIVE GLOW. D.H.Pringle and W.E.J.Farvis.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 836-48 (Nov., 1955).

Detailed examination of the electron energy and density distribution in the negative-glow region of a low-pressure helium discharge has been made with the aid of a screened probe. This structure eliminates much of the inaccuracy inherent in the use of simple Langmuir probes. Earlier results by Emeléus, indicating the existence of three discrete electron groups, have been confirmed and extended and a detailed picture obtained of the conditions near the cathode dark space edge. Spectrophotometric measurements of the intensities of the helium spectral lines confirm the screened probe measurements. A.

537.525.8

2142. DIFFUSION OF LIKE PARTICLES ACROSS A MAGNETIC FIELD. A.Simon.
Phys. Rev., Vol. 100, No. 6, 1557-9 (Dec. 15, 1955).

It is shown that the diffusion rate across a magnetic field due to collision of like-charged particles is derivable from the macroscopic equations of the plasma. However, it is necessary to include the off-diagonal terms in the stress tensor. The resultant diffusion rate does not obey Fick's law and is proportional to the inverse fourth power of magnetic field strength. This diffusion rate is usually smaller than that due to unlike particle collisions, but may sometimes dominate.
A.

537.528

2143. FORMATIVE TIME LAGS IN THE ELECTRIC BREAKDOWN OF LIQUID HYDROCARBONS. R.W.Crowe.
J. appl. Phys., Vol. 27, No. 2, 156-60 (Feb., 1956).

Recent investigations of the time dependence of electrical breakdown in liquid hydrocarbons have led to a disagreement regarding the influence of molecular structure upon the formative time lag. This paper represents an attempt to resolve the discrepancy, and to determine if possible the significance of the time lag in the breakdown process. The experiments involve the application of rectangular pulses of voltage of variable duration and amplitude to the liquids between hemispherical electrodes. The results show definitely that the formative time lag is insensitive to changes in the molecular weight of the hydrocarbon liquid. Consequently, it cannot be associated with the time required for positive ions to cross the spark gap, as has been suggested by other investigators. Its characteristic dependence upon the electrode separation, however, suggests that it may be mainly a measure of the transit time of an electron or an electron avalanche. A.

537.529

2144. DIELECTRIC BREAKDOWN IN SOLIDS. H.Fröhlich and B.V.Paranjape.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 21-32 (Jan., 1956).

It is shown that already at fairly low electronic densities (of the order 10^{14} cm^{-3}) an electron exchanges energy with other electrons quicker than with lattice vibrations, mainly because collisions with the latter are nearly elastic. The notation of an electronic temperature T, which in an external field is higher than the lattice temperature, is then introduced

and it is shown that a stationary state becomes impossible if the field is above a critical strength F_C the breakdown strength. For nonpolar and for polar substances F_C can be expressed in terms of the electronic mobility in weak fields, and of other measurable quantities. A.

537.529 : 621.316.923

2145. STUDIES ON THE MECHANISM OF ELECTRICAL WIRE EXPLOSIONS. W.M.Conn.
Z. angew. Phys., Vol. 7, No. 11, 539-54 (1955). In German.

Gives a comprehensive review of previous work on known mechanisms of the explosion of wires and describes an experimental investigation of the explosions and of the formation of metallic deposits on glass and other materials. There is an extensive bibliography. C.G.Morgan

X-RAYS 537.531

537.531 : 535.33

2146. THE K α DOUBLET OF SULPHUR IN METAL SULPHIDES. A.Faessler and M.Goehring.
Z.Phys., Vol. 142, No. 5, 558-64 (1955). In German.

Wavelengths have been measured for 18 compounds; the mean shift of the K α doublet relative to that for sulphur is +0.33 X.U., corresponding to −0.14 eV energy difference. A.R.Stokes

537.531 : 535.33

2147. Tc K X-RAY SPECTRUM. G.L.Rogosa and W.F.Peed.
Phys. Rev., Vol. 100, No. 6, 1763 (Dec. 15, 1955).

Fluorescent X-ray radiation from 100 mg of $KTc^{99}O_4$ was analysed with a Cauchois-type curved-crystal spectrometer and four K-series X-ray lines of Tc were recorded. The wavelengths accurate to within 0.1 x.u. are: $K\alpha_2$, 677.90; $K\alpha_1$, 673.57; $K\beta_{1,3}$, 600.20; $K\beta_{2,4}$, 588.99; all wavelengths in x.u. A.

537.531 : 535.33

2148. DETERMINATION OF THE INTENSITY OF THE SATELLITE BANDS OF THE $L\alpha$ RAYS FOR ELEMENTS OF ATOMIC NUMBERS 73 TO 92. J.Gomes Ferreira.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1929-32 (Dec. 19, 1955). In French.

See Abstr. 6191 (1955).

537.531 : 535.33

2149. L X-RAY ENERGIES OF Np, Pu AND Am. G.L.Rogosa and W.F.Peed.
Phys. Rev., Vol. 101, No. 2, 591-3 (Jan. 15, 1956).

Five Np, eight Pu and five Am L X-ray transitions have been observed in conventional X-ray fluorescence from 200 mg amounts of Np^{237}, Pu^{239} and Am^{241} using a Cauchois type curved crystal transmission spectrometer. The energies of these transitions have been determined, with reference to K α_1 lines of the elements from Rb through Ag, to an accuracy of 3 to 8 eV. Disagreement with previous measurements by Barton, Robinson and Perlman; Jaffe, Passell, Browne and Perlman; and Day has been found while excellent agreement with the Pu measurements of Cauchois, Manescu and Le Berquier was obtained. A.

537.531 : 535.339

2150. PROPERTIES OF BROMINE AND OTHER ELEMENTS AS FILTERS FOR MONOCHROMATIZATION OF X-RAYS FROM COPPER TARGET. K.Kranjc.
Period. math.-phys. astron. (Zagreb), Vol. 10, No. 1-2, 73-88 (1955).

The use of a bromine filter in addition to a nickel filter, for making copper radiation more nearly monochromatic, is considered theoretically, and it is concluded that it is undesirable because it enhances the ratio of (continuous radiation)/(Cu K radiation) in some parts of the spectrum, and because it introduces a peak of intensity beside the Br absorption edge. The same is true of other elements. Some photographs of MgO taken with bromine-filtered radiation support this view. A.R.Stokes

537.531 : 535.34

2151. PRESSURE OF THE ABSORBING GAS FOR OPTIMUM X-RAY ABSORPTION RISE. B.K.Agarwal.
Z. Phys., Vol. 142, No. 2, 161-2 (1955).

The pressure required for maximum change of intensity at an absorption edge is calculated on the assumption that the ratio of absorption coefficients is given by a Z^b. See also Abstr. 2780 (1955). A.R.Stokes

537.531 : 535.34

2152. ON THE PROBLEM OF X-RAY ABSORPTION IN COMPRESSED FLUIDS. R.Schall and G.Thomer.
Z.Phys., Vol. 142, No. 5, 637-41 (1955). In German.

Schaaffs has concluded (Abstr. 8328/1954) that there is anomalous absorption of X-rays in the high-pressure regions of shock waves. The authors claim that an apparent anomaly arises from the shape of the electrodes used in Schaaffs' experiments. A.R.Stokes

537.531 : 535.34

2153. REMARKS ON A PAPER BY R.SCHALL AND G.THOMER ON THE PROBLEM OF THE ABSORPTION OF X-RAYS BY COMPRESSED FLUIDS. W.Schaaffs.
Z.Phys., Vol. 142, No. 5, 642-5 (1955). In German.

See preceding abstract. It is claimed that Schall and Thomer have misrepresented Schaaffs' experimental work in some respects. A.R.Stokes

537.531 : 535.34

2154. PRELIMINARY RESEARCHES ON THE X-RAY SPECTRA OF ALLOYS AFTER IRRADIATION WITH FAST NEUTRONS. Y.Cauchois.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 942-4 (Oct. 10, 1955). In French.

Thin sheets of an alloy of 5% Ni in Cu were irradiated with fast neutrons, the dose being about 10^{19} per cm^2. The K absorption spectra were changed by the irradiation. A.E.De Barr

537.531 : 535.34 : 548.7

2155. BRILLOUIN ZONES, ELECTRICAL CONDUCTIVITY OF METALS AND X-RAY K-ABSORPTION SPECTRA. C.Kurylenko.
Cahiers de Phys., No. 61, 12-24 (Sept., 1955). In French.

The effects of preferred orientation in the thin sheets used for the absorption studies is discussed; it produces considerable changes in the fringe structure at the K absorption edge. It is also shown that there is no change of fringes when iron is heated through the magnetic change point, but a marked change when it becomes face-centred cubic. W.M.Lomer

537.531 : 535.345

2156. DESIGN OF DIFFERENTIAL X-RAY FILTERS FOR LOW-INTENSITY SCATTERING EXPERIMENTS. J.A.Soules, W.L.Gordon and C.H.Shaw.
Rev. sci. Instrum., Vol. 27, No. 1, 12-14 (Jan., 1956).

The conditions for the thicknesses of the foils of a Ross differential X-ray filter are examined to yield the best accuracy of monochromatic intensity measurement for a given heterogeneous beam of X-rays. The results are applied to the problem of monochromatizing the K α radiation from a copper target X-ray tube using nickel and cobalt foils. The improvement in the differential filter as a monochromator when used with a proportional counter and single-channel pulse-height discriminator is pointed out. A.

537.531 : 535.43 : 548.732

2157. BROADENING OF A BEAM OF X-RAYS IN PASSAGE THROUGH HETEROGENEOUS MATERIAL. M.Lambert and A.Guinier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 16, 1057-9 (Oct. 17, 1955). In French.

See Abstr. 2488 (1950). Multiple low-angle scattering by particles of any shape is considered. Experiments on two carbon blacks confirm that the square of the breadth of the beam increases linearly with the specimen thickness.

A.R.Stokes

537.531.07

2158. WIDE-BEAM FLUORESCENT X-RAY SOURCE. H.V.Larson, I.T.Myers and W.C.Roesch.
Nucleonics, Vol. 13, No. 11, 100-2 (Nov., 1955).

Mono-energetic X-rays ranging from 8.9 keV to 100 keV are produced by irradiating Cu, Cd, La, W, Pb and U targets with the continuous radiation from a 220 kVp X-ray generator. A wide (6 in. dia.) uniform beam was obtained with adequate intensity for instrument calibration and similar purposes. Scattered radiation in the beam was only a few % of the fluorescent radiation.

L.R.Shepherd

537.531.07 : 548.733

2159. A NEW FINE LINE FOCUS X-RAY TUBE. R.Hosemann.
Z. angew. Phys., Vol. 7, No. 11, 532-6 (1955). In German.

The theory and some constructional details of the X-ray tube are given. Performance figures are given, e.g. length of focus, 7 mm, half-value width, 0.13 mm, tube current 13 mA at 50 kV, anode loading 690 watts/mm^2.

A.R.Stokes

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533

2160. SOME ANOMALOUS EMISSION EFFECTS IN LOW ENERGY ELECTRON BEAMS. W.W.H.Clarke and L.Jacob.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 805-16 (Nov., 1955).

Some of the properties of an electron emission system have been investigated by means of a special electron gun, for accelerating voltages in the range 18-30 volts. The voltage was varied in steps of 1 or 2 volt intervals, and it was found that the emission varied in a periodic manner over all regions of the cathode—marginal, extra-axial and central; the variations were greatest for the central region. Here, the change from "normal" to "abnormal" may occur over a one-volt energy interval; an energy change of two volts can alter the periodic pattern and convert a maximum of emission density into a minimum. Changes of temperature of some 30° C also produce profound effects on the form of the distributions. Anomalies also appear in the total current to the axial system of collectors. For example, for every beam energy between 21 and 23.8 volts, there are three separate temperatures of the emitter at which "threshold" current begins to flow. The pattern of standing waves across the emitter has a wavelength of about 0.01 mm. This is interpreted as arising from the presence of a saddle-back field produced by initial velocity effects together with the space charge of the beam. The electrons oscillate in this field. An analogy is afforded by the occurrence of oscillations under certain field conditions for the transition region between lens and mirror in the case of the symmetrical arrangement of electrodes. A.

537.533 : 537.534

2161. THE EFFECT OF SPACE CHARGE DURING THE PROPAGATION OF INTENSE BEAMS OF CHARGED PARTICLES. M.D.Gadovich.
Uspekhi fiz. Nauk, Vol. 56, No. 2, 215-56 (1955). In Russian.

The article brings together the results of published fundamental work on the topic and appears to have been successful in assembling information and in deriving formulae likely to be of use in work with intense beams. 81 refs.

C.R.S.Manders

537.533.2

2162. ELECTRON EMISSION FROM METAL SURFACES AFTER MECHANICAL WORKING. J.Lohff and H.Raether.
Z. Phys., Vol. 142, No. 3, 310-20 (1955). In German.

See also Abstr. 4833/1953. The emission was studied in vacuo (about 10^{-5} mm Hg) using a secondary emission multiplier. The intensity of the emission was correlated with the chemical activity of the emitter and meaningful comparisons with position in the periodic table were made. Thus the emission seems to be a consequence of chemical reactions, and the decay with time is governed by the growth of an oxide layer. It is noted that rubbing with emery paper falsifies the results owing to specific emission from the emery.

A.H.W.Beck

537.533.2

2163. SOME FACTORS INFLUENCING FIELD EMISSION AND THE FOWLER–NORDHEIM LAW. T.J.Lewis.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 938-43 (Nov., 1955).

Departures from the normal Fowler–Nordheim law which have been observed at fields up to 7×10^7 V.cm^{-1} have previously been ascribed to space-charge field distortion. It is shown that certain other effects due to failure of the image law, non-uniformity of work function and to possible surface irregularities could produce similar effects.

A.

537.533.2

2164. THE WORK FUNCTION AND PATCH FIELD OF AN IRREGULAR METAL SURFACE. M.J.Morant and H.House.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 14-20 (Jan., 1956).

In removing an electron from a metal, work has to be done against image-type forces. The classical image potential outside projections on an irregular surface is less than outside a plane surface but it is shown that the resulting lowering of the work function is entirely compensated by a patch field. Exact calculations cannot be made even for the single idealized surface projection for which image calculations are available. However, the axial patch potential for this case been evaluated using an electrolytic tank and this shows that the form of the surface barrier is not affected by surface microgeometry. A.

537.533.33

2165. A POSSIBLE CHROMATIC CORRECTION SYSTEM FOR ELECTRON LENSES. G.D.Archard.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 817-29 (Nov., 1955).

It is shown that a suitably arranged group of four electrodes has properties which make it a useful integral part of a system for the correction of axial chromatic aberration. Its application to the correction system proposed by Scherzer, and to a new simplified system having certain advantages over that of Scherzer is discussed. Curves are given for the chromatic and focal properties of the corrective electrode group, and an example of a corrective system is considered numerically. The effect of this system on off-axial chromatic aberration is investigated, and the possibility of combining it with a system for spherical correction is envisaged.

A.

537.533.335

2166. ON THE SPHERICAL ABERRATION OF MAGNETIC ELECTRON LENSES. W.Glaser.
Optik, Vol. 13, No. 1, 7-12 (1956). In German.

It is shown that the lower limits of spherical aberration derived by Tretner (Abstr. 10247/1954) cannot be upheld since a "trough-shaped" field (analytically complementary to a "bell-shaped" field) yields considerably lower values. The trough-shaped field possesses inferior refractive power, but useful imaging is still possible, though the concept of "focal length" loses its normal meaning.

A.E.I. Research Laboratory

537.533.335

2167. NUMERICAL CALCULATION OF THE INDUCTION OF A NON-ROTATING MAGNETIC ELECTRON LENS. M.Laudet.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1728-30 (Dec. 14, 1955). In French.

The field distribution of a magnetic electron lens, which does not produce rotation of the image, is calculated by an iteration method. Values of the field at various points are shown diagrammatically. A.E.I. Research Laboratory

537.533.335 : 621.385.833

2168. TESTING OF SOME ADJUSTABLE PERMANENT-MAGNET ELECTRON LENSES. G.Langner.
Optik, Vol. 12, No. 12, 554-62 (1955). In German.

Methods of regulating the strengths of electron lenses formed from permanent magnets are described. For a condenser lens, the flux in the magnetic circuit is varied by adjusting the width of an air gap. For the individual adjustment of several lenses excited by the same magnet, auxiliary regulating pieces are provided. Lens strengths can thus be varied over a wide range and the same instrument used for microscopy and diffraction. Measurements of typical lenses are given. A.E.I. Research Laboratory

537.533.35

2169. USE OF A CYLINDRICAL LENS TO REDUCE IMAGE DISTORTION IN REFLECTION ELECTRON MICROSCOPY. C.Fert and B.Marty.
C.R. Acad. Sci. (Paris), Vol. 241, No. 21, 1454-6 (Nov. 21, 1955). In French.

It is shown that a reflection micrograph taken at a viewing angle of the order of 20° can be corrected for distortion, by means of an auxiliary cylindrical lens. The impression of relief is, however, increased. A.E.I. Research Laboratory

537.533.35

2170. HIGH-RESOLUTION PHOTOGRAPHIC EMULSIONS IN ELECTRON MICROSCOPY. G.Möllenstedt.
Optik, Vol. 13, No. 1, 13-24 (1956). In German.

In a previous paper (Kopp and Möllenstedt, Optik, Vol. 1, 327, 1946, the use of maximum resolution plates for electron microscopy was described, and a plate resolution of 9 microns was obtained. The present paper describes a one-stage electron microscope, specially designed for use with maximum resolution plates. The advantage claimed is that the field of view is about a thousand times greater than in the normal instrument and therefore no mechanical stage is necessary. The electron optical image is viewed in a travelling microscope. Methods are described for overcoming the charging-up effects which would otherwise occur in this type of emulsion. A plate resolution of 3 microns has been obtained.
A.E.I. Research Laboratory

537.533.35 : 539.27

2171. SPECIMEN THICKNESS AND IMAGE RESOLUTION IN ELECTRON MICROSCOPY. V.E.Cosslett.
Brit. J. appl. Phys., Vol. 7, No. 1, 10-13 (Jan., 1956).

The working rule that the resolution obtainable in the electron image of a biological specimen is of the order of one-tenth its thickness is quantitatively explained in terms of the energy loss of electrons scattered in the specimen and of the chromatic aberration of the objective lens. This limitation holds true down to the thinnest sections (100-200 A) that can be cut at present. That they normally do not show a resolution approaching 20 A is ascribed to lack of contrast. The use of a filter lens, rejecting all electrons that lose more than 10 V, would improve both contrast and resolution. Its use is even more important for rendering visible carbonaceous structures of size comparable with the instrumental resolving power. A lower accelerating voltage than currently used for electron microscopy is desirable for specimens of poor contrast. A.

537.533.73

2172. ELECTRON DIFFRACTION BY THE SURFACE OF A COPPER SINGLE CRYSTAL AT HIGH TEMPERATURE. C.Menzel-Kopp and E.Menzel.
Z. Phys., Vol. 142, No. 3, 245-58 (1955). In German.

Studies the influence of temperature on electron diffraction by reflection and transmission. Distortion of the electron beam, which is caused by the heating coil, is overcome by the use of alternating periods of heating and observation. Particular attention is paid to the change of amplitude of the atomic vibrations with temperature and its effect on the intensities of the diffracted beams. J.Thewlis

537.533.74

2173. THE NUCLEAR SCATTERING OF ELECTRONS AND POSITRONS AT 10 MeV. W.Bosley and I.S.Hughes.
Phil. Mag., Vol. 46, 1281-6 (Dec., 1955).

Measurements have been made on the single (large angle) and multiple Coulomb scattering of electrons and positrons in nuclear emulsions. The results obtained for single scattering are in general agreement with the theoretical expectations, and appear to confirm the prediction of a difference between the nuclear scattering of electrons and positrons at 10 MeV, although the data are insufficient to permit detailed comparison. The results for the multiple scattering show an unexplained difference between the two types of particle. The number of positrons observed to annihilate in flight is in agreement with the theoretical predictions of Dirac (1930). A.

537.533.74

2174. DOUBLE SCATTERING OF ELECTRONS WITH MAGNETIC INTERACTION. II. DEPOLARIZATION. H.Mendlowitz and K.M.Case.
Phys. Rev., Vol. 100, No. 6, 1551-7 (Dec. 15, 1955).

For Pt I, see Abstr. 1901 (1955). The depolarization occurring in attempts to measure the electron's gyromagnetic ratio by double-scattering experiments in a magnetic field is discussed. Formulae are found for the effects expected to be most significant. These are applied to estimate the possible accuracy obtainable. One part in 10^5 seems to be quite feasible. In addition, formulae are appended which permit rapid estimation of other depolarization effects. A.

537.533.74

2175. SCATTERING OF AN ELECTRON BY AN ATOM AND REARRANGEMENT COLLISIONS. T.-Y.Wu.
Canad. J. Phys., Vol. 34, No. 2, 179-89 (Feb., 1956).

For the problem of the scattering of an electron by a hydrogen atom, the complete equivalence is shown of the treatment of Trainor and Wu based on symmetry considerations and that of Altshuler giving a direct proof of the method of Mott and Massey. A generalization of the treatment of Altshuler to scattering processes involving non-identical particles or other rearrangement collisions is made. Also, the usual treatment involving matrix elements for transitions between states belonging to two different Hamiltonians is discussed and justified. Finally, the recent treatment by Dirac of rearrangement collisions is discussed, and it is shown that a correct formulation of the method and interpretation of the result give exactly the same result as in the usual treatment. A.

537.533.75

2176. INVESTIGATION OF THE CHARACTERISTIC ENERGY LOSSES BY THE OPPOSING FIELD METHOD. G.Haberstroh and H.Raether.
Naturwissenschaften, Vol. 42, No. 19, 531 (Oct., 1955). In German.

Measurements were made of the number and angular distribution of electrons of incident energies between 20 and 50 keV, after traversing thin aluminium foils, in energy ranges corresponding to known small differences in potential between cathode and collector. The first characteristic energy loss occurs at 15.0 eV and the second at 29.4 eV. J.Franks

537.533.75

2177. EXPERIMENTAL EVIDENCE FOR THE COLLECTIVE NATURE OF THE CHARACTERISTIC ENERGY LOSS OF ELECTRONS IN SOLIDS — STUDIES ON THE DISPERSION RELATION OF PLASMA FREQUENCY. H.Watanabe.
J. Phys. Soc. Japan, Vol. 11, No. 2, 112-19 (Feb., 1956).

The energy loss of 25 kV electrons was studied by a modified velocity analyser of Möllenstedt type. By means of the analyser the diagram was obtained which shows the variation of energy loss with the scattering angle. The specimens studied were Be, Mg, Al, Ge and C (graphite). In the diagram six types of patterns were classified, in which two are of fundamental importance: (1) The first type is the sharp energy-loss lines such as first discovered for Al and Be by Ruthemann. In the present experiment it was found that the value of energy loss of these lines increases with the scattering angle. To represent this relation an empirical formula was established. In addition, a theoretical formula was derived from the dispersion relation in Bohm—Pines' plasma oscillation theory. These two formulae are in good agreement for the lines of Be (19 eV), Mg (10.3 eV) and Al (14.8 eV). This agreement proves most decisively that the sharp lines are caused by the excitation of the collective plasma oscillation. For Ge (16.4 eV) and C (7.3 eV) the agreement is less perfect. (2) The lines of second type are observed at 23 eV for Al and 25 eV for C. They are rather diffuse and their energy losses do not vary with the scattering angle. The author attributes them to the excitation of individual electrons in energy bands. The value 23 eV for Al is in agreement with the energy difference between the large peaks in the fine structure of L-absorption edge. According to the theory the curving and the position of the patterns in the first type are insensitive to the temperature of the specimen, being in agreement with the experiment. A

537.533.79

2178. SPACE-CHARGE WAVES IN ACCELERATED AND DECELERATED ONE-DIMENSIONAL ELECTRON STREAMS. R.Müller.
Arch. elekt. Übertragung, Vol. 9, No. 11, 505-12 (Nov., 1955). In German.

Coefficients showing the growth or decay of space-charge waves are calculated for a potential distribution where the steady electron velocity is Kz^{α}, α being arbitrary and including $\alpha = \frac{1}{2}$ (linear potential distribution) and $\alpha = 0$ constant potential) as special cases. The effect of reversing the electron stream is considered, and approximate solutions in terms of sine functions given for practical conditions.
A.Reddish

537.533.8

2179. SECONDARY ELECTRON EMISSION BY PRIMARY ELECTRONS IN THE ENERGY RANGE OF 20 KILOVOLTS TO 1.3 MeV. B.L.Miller and W.C.Porter.
J. Franklin Inst., Vol. 260, No. 1, 31-9 (July, 1955).

A linear accelerator served as the variable energy source. The beam was passed through a magnetic spectrometer with a resolution of ±4% in momentum. Results are presented for Au, Cu, W, Be, Al and Ag, and are in good agreement with previous work. Some preliminary studies on the secondary-emission characteristics of insulators, in this energy range, are also described. E.A.Ash

537.533.8

2180. ON THE EFFECT OF DISCRETE ENERGY LOSSES OF ELECTRONS ON THE STRUCTURE OF BREMSSTRAHL ISOCHROMATS. L.Albert.
Z. Phys., Vol. 143, No. 5, 513-32 (1956). In German.

The structure of isochromats was examined with a focusing vacuum X-ray spectrometer at 2 kV. A stepped structure was obtained near the threshold potential; the widths of the steps were characteristic of the anti-cathode material. The structure is due to the discrete Ruthemann energy losses in the anti-cathode. The minimum between 10 and 20 V observed with a massive anti-cathode is attributed to the periodic potential of the anti-cathode lattice and to the shape of the energy loss spectrum of the electrons. J.Franks

537.533.8

2181. ENERGY DISTRIBUTION AT LARGE ANGLES OF HIGH-ENERGY ELECTRONS IN BREMSSTRAHLUNG. D.G.Keiffer and G.Parzen.
Phys. Rev., Vol. 101, No. 4, 1244-5 (Feb. 15, 1956).

The energy distribution of high-energy electrons, that have been scattered by the nuclear potential and have lost energy by bremsstrahlung, has been investigated. It has been found that there is a peak in the energy distribution which occurs at energies of the order of mc^2. The nature of and reasons for the peak are discussed. Formulae for the energy distribution near the peak and for the area under the peak are given. Similar results apply also to pair production. A.

537.533.9 : 537.311.1

2182. ELECTRON BOMBARDMENT EFFECTS IN THIN DIELECTRIC LAYERS. W.E.Spear.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 991-1000 (Dec., 1955).

Dielectric layers of mica, Pyrex, arsenic sulphide and antimony sulphide, between 0.7 and 4 micron thick, have been investigated under electron bombardment with electron energies up to 50 keV. The specimens carry evaporated Al electrodes, which are practically transparent to the primary electrons. The results include transmission curves for the primaries; the range values are in agreement with the Thomson—Whiddington law. With both electrodes at the same potential a steady secondary current begins to flow to the bottom electrode when the bombarding electrons have penetrated about half the specimen. Experimental values of primary and secondary currents for specimens of different thickness and dielectric fall on common curves when plotted against a suitable independent variable. The secondary current is shown to depend on the absorbed energy. Results for mica with applied fields up to 10^6 V.cm^{-1} across the specimen are included. An interpretation of the secondary current curves is given in terms of the displacement of charge carriers in the space-charge field within the dielectric. A.

537.534

2183. ANTIPROTONS. O.Chamberlain, E.Segrè, C.Wiegand and T.Ypsilantis.
Nature (London), Vol. 177, 11-12 (Jan. 7, 1956).

Expected properties of the antiprotons are noted and recent experiments at Berkeley which indicated their presence are discussed. G.E.Brown

537.534

2184. A STOCHASTIC METHOD OF ACCELERATING PARTICLES. É.L.Burshtein, V.I.Veksler and A.A.Kolomenskiĭ.
Some problems in the theory of cyclical accelerators. Moscow: USSR Academy of Sciences (1955) pp. 3-6. In Russian.

It is shown that particles may be accelerated by a stochastic method, in which the phase of the voltage in each field as the particle enters it is a random quantity. This phenomenon has been observed, and it may also account for certain properties of cosmic rays. J.B.Sykes

537.534

2185. NON-LINEAR REGENERATIVE EXTRACTION OF SYNCHROCYCLOTRON BEAMS. K.J.Le Couteur and S.Lipton.
Phil. Mag., Vol. 46, 1265-80 (Dec., 1955).

To extract a beam of a maximum energy from a synchrocyclotron, the deflector must be placed at the edge of the magnet, where the magnetic field falls off very rapidly and non-linearly with radius. This presents an analytical problem of

coupled non-linear differential equations with periodic coefficients which is solved approximately. The results have been checked by electronic computation. It is concluded that a non-linear deflector can extract the beam with higher energy and perhaps greater theoretical efficiency than the linear one at present working at Liverpool. The new method is mechanically simpler than the old for it has no peeler, only a regenerator. The mathematics has interest apart from this application, for the difficulty of handling these coupled cyclotron equations is a major obstacle to the development of new particle accelerators of the fixed field type. A.

537.534

2186. REGENERATIVE BEAM EXTRACTION ON THE CHICAGO SYNCHROCYCLOTRON A.V.Crewe and U.E.Kruse. Rev. sci. Instrum., Vol. 27, No. 1, 5-8 (Jan., 1956).

The proton beam extraction system of the 450 MeV synchrocyclotron is described. The nonlinear theory of LeCouteur has been applied and an external beam of 10^{11} protons per second has been obtained. A.

537.534 : 621.384.612

2187. THE SACLAY PROTON-SYNCHROTRON PROJECT. H.Bruck and R.Lévy-Mandel. Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 1, 423-41 (1955). In French.

The relative advantages of constant- and alternating-gradient (c.g. and a.g.) machines for 1.75 GeV are examined. It is shown that, for similar mechanical tolerances, there is no advantage in cost in using the a.g. type, while the c.g. type should give a 10 times larger current. Details of the proposed c.g. machine are then given. The chief difference from the Brookhaven machine is that the vacuum chamber will be substantially smaller in section, permitting a magnet of total weight 840 tons, and an initial field-rise rate of 20 000 G/sec. Operation is hoped to begin early in 1958. J.H.Fremlin

537.534.3

2188. MASS SPECTROGRAPH OF THE (CZECHOSLOVAK) RESEARCH INSTITUTE FOR VACUUM TECHNOLOGY. M.Ondráček. Slaboproudý Obzor, Vol. 16, No. 11, 593-601 (1955). In Czech.

Describes the overall organization and some constructional details of an original magnetic mass spectrograph. The instrument is divided into three units: the spectrograph proper, a device for introducing doses of the analysed gas into the instrument, and ancillary electrical equipment. The spectrograph consists of: (1) an ion tube having a diameter of 35 mm and a radius of curvature of 15 cm, and operating with voltages up to 2 kV; (2) an electromagnet with a winding of 22 000 turns producing deflecting fields up to 5.5 kG, the beam deflection angle being 90°; (3) an ion source in which the gas particles are ionized by a magnetically focused beam of electrons, which are emitted by a tungsten cathode, and (4) a collector absorbing the ions. The electrical equipment consists of power supplies for the ion source, the magnet and ion tube; the latter two supplies have a stability of 10^{-6}. The collector current is amplified by means of an amplifier fitted with a d.c./a.c. vibrating-capacitor transducer. The instrument is capable of analysing atomic masses up to 400. During the analysis it is necessary to maintain a pressure of 10^{-3} mm Hg in the ion source. The paper is illustrated by a number of drawings and diagrams, and contains some experimental data relating to H and Ne. There are 29 references.

R.S.Sidorowicz

537.534.2

2189. A DOUBLE-FOCUSING ARRANGEMENT APPLICABLE TO ORDINARY MASS-SPECTROMETERS. R.Vauthier. C.R. Acad. Sci. (Paris), Vol. 241, No. 20, 1388-90 (Nov. 14, 1955). In French.

Ions emerging from the outer parts of the ion-source of a mass spectrometer have greater energies than those emerging from the centre. This fact can be used to counteract, by a double-focusing technique, the effect of the spherical aberration of the instrument. A.E.I. Research Laboratory

537.534.3 : 539.172.13

2190. ON HEAVY PARTICLE SPECTROSCOPY TECHNIQUE, ITS APPLICATION TO SCATTERING MASS ANALYSIS AND TO THE $Al^{27}(d,\alpha)Mg^{25}$ AND $Al^{27}(d,p)Al^{28}$ REACTIONS. H.A.Enge. Univ. Bergen Årbok, (1954; publ. 1955) No. 1, 101 pp.

The deuteron beam from a corona-stabilized 2 MeV air-insulated Van de Graaff generator was used to irradiate aluminium targets. Alpha-particles and protons from the $Al^{27}(d,\alpha)Mg^{25}$ and $Al^{27}(d,p)Al^{28}$ reactions respectively were passed into a magnetic spectrometer, and were recorded on photographic plates after deflection through 180°. A resolving power of 800 was obtained. Using incident energies of 1.8 MeV, 2.0 MeV and 2.1 MeV eleven (or possibly twelve) alpha-particle groups were assigned to the $Al^{27}(d,\alpha)Mg^{25}$ reaction, leading to estimations of the excited levels in Mg^{25} in good agreement with those of Endt (1952). Fifty proton peaks were assigned to the $Al^{27}(d,p)Al^{28}$ reaction and the corresponding levels in Al^{28} were calculated. In particular the existence of a low-lying level at 31.2 keV ± 0.23 keV was confirmed.

D.R.Chick

537.534.72 : 539.155.2

2191. PRODUCTION AND UTILIZATION OF ELECTROMAGNETICALLY ENRICHED ISOTOPES. M.L.Smith. Nature (London), Vol. 177, 157-61 (Jan. 28, 1956).

Brief report of a conference held in Sept. 1955 at the Atomic Energy Research Establishment, Harwell. The following fields were covered: ion sources, collector problems, chemical aspects and target preparation, utilization, analysis of isotopic abundance, the design of electromagnetic separators, and the use of the separator for active materials as a tool in nuclear research.

537.534.74

2192. PROTON-PROTON SCATTERING FROM 40 TO 95 MeV. U.E.Kruse, J.M.Teem and N.F.Ramsey. Phys. Rev., Vol. 101, No. 3, 1079-85 (Feb. 1, 1956).

Proton-proton scattering experiments between 40 and 95 MeV are described. Two methods for observing the proton-proton differential scattering cross-section were employed; in the first, hydrocarbon scatterers were used to obtain the cross-section at 90° as a function of energy. In the second, liquid hydrogen was used for the target and the angular distribution at 95 and 70 MeV was obtained to angles of 25°. Throughout, a Faraday cup was used to monitor the incident beam. The cross-section rises smoothly from 4.65 ± 0.25 mb at 95 MeV to 11.4 ± 0.8 mb at 41 MeV. At 95 MeV the cross-section shows a slight increase to smaller angles; the ratio between 40° and 90° is 1.06 ± 0.03. A.

537.534.75

2193. PHASE-SHIFT ANALYSIS OF SINGLE-CHANNEL REACTIONS. H.Lustig and J.M.Blatt. Phys. Rev., Vol. 100, No. 3, 777-90 (Nov. 1, 1955).

The calculation of phase shifts from experimental data has usually involved "matching" of differential cross-section data at a number of angles equal to the number of assumed nonzero phase-shifts, followed by minimization of the errors at other angles. It is possible to derive n simultaneous equations for n assumed phase-shifts by calculating n "moments" of a suitable expression for the differential cross section. Such theoretical expression was derived for the problem of single-channel elastic scattering of charged particles with channel spin ½, and the integrations were performed. For each particular experimental problem, the cross-section data are to be integrated numerically. Then n simultaneous equations are obtained which may be solved for n phase shifts. As an ex-

ample of this method, proton–alpha scattering data were analysed at an incident energy of 5.78 MeV and values for five assumed phase shifts were obtained. A.

537.534.75

2194. RANGE–ENERGY RELATIONS FOR LIGHT NUCLEI IN AIR AND NUCLEAR EMULSION. D.L.Livesey.
Canad. J. Phys., Vol. 34, No. 2, 203-15 (Feb., 1956).

An empirical method has been developed for estimating the effective charge of ions between Z = 3 and Z = 10 over a wide range of velocities in air and nuclear emulsion. The results are used in conjunction with a power-law function for the variation of stopping-power with velocity to derive range–energy relations for these ions. The curves are compared with all available experimental data, and agreement within the limits of experimental error is obtained in all cases except those of fluorine and neon ions in air. A.

537.534.75

2195. STOPPING POWER OF L-ELECTRONS. M.C.Walske.
Phys. Rev., Vol. 101, No. 3, 940-4 (Feb. 1, 1956).

The Bethe theory of the energy loss of fast charged particles is extended to treat explicitly the stopping contribution of L-shell electrons. A summary of the effect of binding corrections on stopping power is given. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

2196. A STUDY OF THE ELECTRON BEAM FROM A MASS SPECTROMETER ION SOURCE. R.Vauthier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 16, 1033-6 (Oct. 17, 1955). In French.

The variation in ion current for changes in total electron current and magnetic field for a mass spectrometer ion source is described. From this behaviour choice of a suitable operating point for the ion source can be made. A.J.Egginton

537.542

2197. RESPONSE OF INORGANIC SCINTILLATORS EXCITED BY THE ENERGY OF INCIDENT RADIATION. A.Meessen.
Ann. Soc. Sci. Bruxelles I, Vol. 69, No. 2, 102-16 (1955). In French.

A general theoretical formula is derived, giving for a NaI–Tl crystal the specific fluorescence as a function of ionization density. The lowering of efficiency at high densities is explained. The effect of different conditions at the crystal surface is included and also those of internal conversion in the activator centres and of quenching processes in the matrix lattice. G.F.J.Garlick

537.542 : 539.166.08

2198. CONSTRUCTION OF A $\gamma-\gamma$ AND HEAVY-PARTICLE–γ COINCIDENCE SPECTROMETER. APPLICATION TO THE $B^{10}(d,p)B^{11}$ REACTION. S.Gorodetzky, A.Gallmann, M.Croissiaux and R.Armbruster.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1743-6 (Dec. 14, 1955). In French.

A spectrometer using two NaI(Tl) crystals, and giving about 2×10^{-8} sec resolution, is described briefly. The performance is illustrated by observations on proton and γ-ray groups from the $B^{10}(d,p)B^{11}$ reaction. J.J.Wilkins

537.542

2199. RESPONSE OF SODIUM IODIDE CRYSTALS TO ALPHA PARTICLES AND ELECTRONS AS A FUNCTION OF TEMPERATURE. E.der Mateosian, M.McKeown and C.O.Muehlhause.
Phys. Rev., Vol. 101, No. 3, 967-71 (Feb. 1, 1956).

In an attempt to determine the mechanism causing the lower scintillation efficiency of alpha particles in NaI(Tl) crystals relative to the scintillation efficiency of electrons, the response of pure NaI and thallium-activated NaI crystals to alpha particles and electrons was studied as a function of temperature. Crystals were grown for this investigation both by the Bridgman and Kyropoulos methods. The magnitude of the scintillations per unit of energy loss in the crystals varied with temperature in a way which agreed with predictions of qualitative theories. The ratio of the alpha-particle response to the electron response per unit energy, though a constant with temperature for the crystals grown by the Bridgman method (alpha response/e^- response = about 0.7) showed an interesting temperature dependence for crystals grown by the Kyropoulos method. For a "pure" NaI crystal grown by the Kyropoulos method this ratio attained a value as high as 1.5 at -150^0 C, indicating that the alpha particle was more efficient than the electron at this temperature. In view of this, proposed explanations for the lower efficiency at room temperature such as "local saturation" of scintillation centres or the loss of energy by "hard collisions" are re-examined. A temperature-dependent effect in the resolution of alpha-particle peaks is also reported and discussed. A.

537.542 : 621.387.464

2200. A SCINTILLATION COUNTER FOR THE ASSAY OF RADIOACTIVE GASES. D.R.Stranks.
J. sci. Instrum., Vol. 33, No. 1, 1-4 (Jan., 1956).

A glass chamber, with a plastic scintillator serving as one wall, may be used to assay gaseous samples of weak β-emitting nuclides (notably C^{14}). The specific activities of duplicate samples can be reproduced to $\pm$ 0.5%. Since the observed counting rate of an active gas sample is independent of gross impurities and the chemical form of the nuclide, sample preparation is simpler and faster than for other gas-counting methods. The scintillation counter assembly can be readily adapted to the assay of both liquid and solid samples; the method described for liquid assays has certain advantages over existing methods. A.

537.542

2201. ON AN ARRANGEMENT FOR ELECTRONIC SUMMATION ON TWO CHANNELS PERMITTING DETECTION OF PAIRS IN A BACKGROUND OF PARASITIC PARTICLES. APPLICATION TO THE MONOPOLE RAY OF OXYGEN 16. S.Gorodetzky, R.Armbruster, P.Chevallier, A.Gallmann and R.Manquenouille.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 482-3 (Aug. 1, 1955). In French.

The scintillation counter arrangement described detects electron–positron coincidences (resolving time about 10^{-8} sec) and, by means of gating and summation circuits, enables the total electron + positron energy to be measured. A block diagram is given. The performance is illustrated by measurements of pairs from the 6.05 MeV level of O^{16}, showing an energy resolution of about 14%. J.J.Wilkins

537.542

2202. AN ARRANGEMENT FOR SUBTRACTING COUNTS USING DEKATRON TUBES. A.Coche.
J. Phys. Radium, Vol. 16, No. 11, 861-3 (Nov., 1955). In French.

A method of subtracting the counts from two Geiger counters is described; the method employs a dekatron and two triode-hexode gating circuits. A.J.Egginton

537.542

2203. A METHOD OF CONTINUOUSLY CONTROLLING PULSED COUNTING EQUIPMENT. A.Fréon.
J. Phys. Radium, Vol. 16, No. 11, 892-3 (Nov., 1955). In French.

A brief review of the problems in controlling pulsed counting equipment continuously is given and method of solving them described. A.J.Egginton

537.542 : 535.371

2204. PULSED PHOTOMULTIPLIERS FOR FAST SCINTILLATION COUNTING. S.Singer, L.K.Neher and R.A.Ruehle.
Rev. sci. Instrum., Vol. 27, No. 1, 40-3 (Jan., 1956).

A pulsed 931-A photomultiplier and TW-10 travelling oscilloscope have been used to measure the scintillation decay times of (a) transtilbene, (b) terphenyl-in-toluene, and (c) polystyrene plastic containing 1% terphenyl, 0.03% α-NPO, and 0.01% zinc stearate. The times for 1/e decay are (a) $4 \pm 1 \times 10^{-9}$ sec, (b) $2.2 \pm 0.3 \times 10^{-9}$ sec and (c) $2.2 \pm 0.3 \times 10^{-9}$ sec. The behaviour of the multiplier with large collector currents was studied, using a synchronized flash lamp. Linear currents up to 1.5 A and maximum currents up to 15 A were obtained. Currents in the ampere range can give rise to an oscillation which may limit the application of pulsed photomultipliers. A.

IONIZATION. THERMIONICS 537.56/58

537.562

2205. PRECISION MEASUREMENTS OF IONIZATION COEFFICIENTS IN UNIFORM STATIC FIELDS.
R.W.Crompton, J.Dutton and S.C.Haydon.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 2-13 (Jan., 1956).

Recent work has shown that the growth of ionization currents in air and nitrogen up to high values of the parameter pd (where p is the gas pressure and d the gap distance) follows the well-known generalized Townsend equation and that the observed breakdown potentials are in agreement with those calculated from the Townsend breakdown criterion. Having established the nature of the general mechanism the next stage is to determine the ionization coefficients α and ω/α as accurately as possible. This paper gives an analysis of the errors in the coefficients arising from experimental errors in the measurement of the ionization currents, and on the basis of the analysis defines the experimental conditions necessary for the accurate determination of the coefficients at high values of pd in hydrogen. The apparatus designed to satisfy these conditions is described, and the values of the ionization coefficients, determined for a range of pd from about 200 to 900 mm Hg cm in hydrogen, are given. Investigation of the effect of the state of the cathode surface on the secondary ionization coefficient showed that even at the comparatively high value of pd about 350 mm Hg cm in hydrogen, the cathode played a significant role in the growth of ionization currents and thus in the setting of the breakdown criterion. A.

537.562

2206. MASS SPECTROMETRIC STUDY OF BARIUM OXIDE VAPOR. M.G.Inghram, W.A.Chupka and R.F.Porter.
J. chem. Phys., Vol. 23, No. 11, 2159-65 (Nov., 1955).

Ions formed by electron bombardment of the vapour in thermodynamic equilibrium with BaO solid have been studied mass spectrometrically. The BaO solid was heated in a Knudsen cell and a sample of the effusing vapour entered the ion source of a mass spectrometer. At cell temperatures between 1500°K and 1800°K, ion currents of Ba^+, BaO^+, Ba_2O^+, $Ba_2O_2^+$ and $Ba_2O_3^+$ were observed. The variations of ion intensities with temperature were measured and appearance potential curves were obtained. Possible mechanisms of ion formation were considered, and evidence for the existence of gaseous molecular species of BaO, Ba_2O, Ba_2O_2 and Ba_2O_3 was obtained. The major molecular species, effusing from the knudsen cell, was BaO. A thermodynamic treatment of ion currents yields the following heats of reaction:

$BaO(s) = BaO(g)$,	104 ± 4 kcal/mole at 0°.
$BaO(g) = Ba(g) + O(g)$,	130 ± 5 kcal/mole at 0°.
$Ba_2O_2(g) = 2BaO(g)$,	89 ± 11 kcal. at 1700°.
$Ba_2O(g) = Ba(g) + BaO(g)$,	93 ± 17 kcal. at 1700°.

A.

537.563

2207. METASTABLE IONS IN MASS SPECTRA.
H.M.Rosenstock, A.L.Wahrhaftig and H.Eyring.
J. chem. Phys., Vol. 23, No. 11, 2200 (Nov., 1955).

Discusses production of ions decomposing in transit, (metastable ions); predicts that with suitable ion optics, metastable transitions with continuous range of half-lives from about 10^{-12} sec to some upper limit determined by instrumental problems, could be detected. States that observed differences in appearance potentials of metastable and daughter ions peaks agree with theory, and points out that no simple relation between peak intensities of initial, metastable, and daughter ions may be expected. N.M.King

537.563

2208. MASS SPECTROMETRIC INVESTIGATION OF ACTIVE NITROGEN. D.S.Jackson and H.I.Schiff.
J. chem. Phys., Vol. 23, No. 12, 2333-8 (Dec., 1955).

A small, central portion of an active nitrogen stream was continuously sampled into a mass spectrometer. The ratio of ion intensities at masses 14 to 28 was found to be higher than that for normal nitrogen at the same pressure. The ionization efficiency curves at mass 28, in the presence and in the absence of the discharge were superimposable, but those at mass 14 were quite different. The difference Δ 14, between these two curves was plotted against the applied electron voltage. A discontinuity in this Δ 14 curve showed that it resulted from two processes. The appearance potentials for these two processes were $14.7_2 \pm 0.2_6$ eV and 16.1 ± 0.3 eV. The lower value clearly indicated the presence of ground state atoms in active nitrogen. Several processes capable of producing the higher value are discussed. The concentration of active species is estimated to be between 0.1 and 1%. A.

537.564

2209. LOSS OF TWO ELECTRONS BY NEGATIVE IONS IN COLLISIONS WITH ATOMS AND MOLECULES.
V.M.Dukel'skiĭ and N.V.Fedorenko.
Zh. éksper. teor. Fiz., Vol. 29, No. 4(10), 473-8 (1955).
In Russian.

Production of positive ions, in collisions of Cl^-, Br^-, I^-, Na^-, Sb^-, Bi^- and Sb_2^- with atoms of helium and argon and with molecules of nitrogen and hydrogen is studied with a spectrometer. In these collisions the negative ions lose two electrons. The cross-sections are of the order $10^{-17} - 10^{-16}$ cm^2. The dissociation of Sb_2^- and Bi_2^- is observed.
G.E.Brown

537.564

2210. PREBREAKDOWN CURRENT IN THE TOWNSEND DISCHARGE. P.L.Auer.
Phys. Rev., Vol. 101, No. 4, 1243 (Feb. 15, 1956).

The rigorous solution for the transient current in a Townsend discharge presented in a previous paper is presented in an alternate form. A simplifying approximation is discussed and compared with the rigorous solution. A.

537.564 : 537.533.74

2211. THE IONIZATION BY ELECTRONS OF THE EXCITED 2s AND 2p STATES OF ATOMIC HYDROGEN. P.Swan.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1157-60 (Dec., 1955).

The cross-sections for ionization by electrons of H2s and H2p have been evaluated in the energy range 5-100 eV. First-order perturbation theory is employed, the ejected electron being described by a Coulomb wave function, and the bombarding electron by plane waves both before and after collision. The H2s cross-sections are larger than the h^2p values, but both are much greater than the cross-section for ionization of the ground state H1s. The classical cross-section formula agrees roughly with the H2p($m = \pm 1$) results, but is considerably smaller than the H2p($m = 0$) and H2s cross-sections. A.

537.568

2212. ION-ATOM INTERCHANGE IN AIR. R.F.Potter.
J. chem. Phys., Vol. 23, No. 12, 2462-3 (Dec., 1955).

An ion having a mass of 30 a.m.u. was observed (unpublished work) in the spectrum of air. It is suggested that it could be produced by the reaction $O^+ + N_2 \rightarrow NO^+ + N$ taking place in the ionization chamber, for the appearance potential for the mass 30 ion peak was approximately the ionization potential of atomic oxygen and not that of NO. Support is thus given to the idea (D.R.Bates, Abstr. 6255/1955) of ion-atom interchange in the ionosphere. W.Good

537.58

2213. COMMENTS ON "TRANSFORMATIONS IN PLAIN CARBON STEELS". F.C.Frank and K.E.Puttick.
J. appl. Phys., Vol. 26, No. 12, 1522 (Dec., 1955).

It is suggested that the thermionic emission electron micrographs of transformations in plain carbon steels may be interpreted on conventional lines, avoiding Heidenreich's suggestion (Abstr. 8878/1955) of diffusionless transformations at high temperatures. Most of the observations can be explained if it is assumed that freshly formed pearlite has a uniformly enhanced emissivity. W.M.Lomer

537.583

2214. ALUMINIUM–MAGNESIUM ALLOYS AS SECONDARY EMISSION LAYERS. M.Biermann and W.Krüger.
Nachrichtentechnik, Vol. 5, No. 10, 470-2 (Oct., 1955). In German.

An experimental study of field-dependent secondary emission from differently treated and formed surfaces and a note on their use in photomultipliers. C.G.Morgan

COSMIC RAYS 537.591

537.591.1

2215. INTENSITIES OF LOW ENERGY μ-MESONS AND N-COMPONENT NEAR SEA LEVEL AT 24° N. S.Kaneko, T.Kubozoe and M.Takahata.
J. Phys. Soc. Japan, Vol. 10, No. 10, 915-16 (Oct., 1955).

At this latitude slow particles and stars have been observed in 600 and 1000 micron nuclear plates made from G5 emulsions in gel form in tunnels and exposed under 15 ± 5 g/cm^2 air equivalent at sea level during 2-3 months. Differential vertical intensity at 15 ± 5 g/cm^2 is $(2.6 \pm 0.2) \times 10^{-6}$ g^{-1}.sec^{-1}sterad. This estimate is based on a zenith-angle dependence $\cos^n \theta$ with n = 3.2. The results seem inconsistent with the rapid fall in the low-momentum region of the spectrum of del Rosario and Dávila-Aponte. The frequency of stars with three or more heavy prongs, namely 0.23 ± 0.04 per cm^3 per day, is quite small compared with that observed at higher latitude by George and Evans. E.W.Kellermann

537.591.1

2216. ON THE BAROMETER EFFECT ON THE HARD COMPONENT OF THE COSMIC RADIATION. H.Trefall.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 953-61 (Nov., 1955).

The interpretation of the observed partial correlation between the meson intensity at sea level and the barometric pressure, the other independent variables of the regression equation being the height of the 100 mb level and the stratospheric temperature, is discussed. It is shown that even though the decay effect due to changes in the height of the meson-producing layer is represented by a separate term in the regression equation, the barometer term does not represent a pure absorption effect but contains also a contribution from the μ—e decay. This decay contribution is due to the relativistic time dilation which makes the mean life of a μ-meson in the atmosphere depend on its energy loss and thereby causes its survival probability to change with changing sea-level pressure even if the height of the meson-producing layer remains constant. The decay effect is found to constitute about one third of the barometric effect observed in experiments performed at sea level. The simple total correlation between the meson intensity and the sea-level pressure is also discussed. A.

537.591.1

2217. INTERPLANETARY MAGNETIC FIELDS AND COSMIC RAYS. L.Davis, Jr.
Phys. Rev., Vol. 100, No. 5, 1440-4 (Dec. 1, 1955).

The existence in the region around the sun of a field-free cavity in the galactic magnetic field seems indicated by the low-energy cosmic rays that reach the earth from the sun. Such a cavity would be produced by the solar corpuscular emission. A mean radius of the order of 200 times the distance from the sun to the earth may be estimated for this cavity by balancing the flux of momentum against the lateral pressure exerted by a field of 10^{-5} gauss. Such a cavity would trap cosmic rays of energy less than 100 BeV for periods long compared to a sunspot cycle, but does not seem to make possible a solar origin of cosmic rays. Expected fluctuations in cavity size would explain the 4% fluctuation in cosmic-ray intensity observed by Forbush. A simple model of the cavity is considered in some detail, rates of escape from and entry to the cavity, acceleration by the Fermi mechanism, and change in energy density being estimated. More complicated models involving a solar magnetic field are considered briefly. A.

537.591.1

2218. OBSERVATIONS ON STARS AND HEAVY PRIMARIES RECORDED IN EMULSIONS FLOWN IN VIKING ROCKET No.9. H.Yagoda.
Canad. J. Phys., Vol. 34, No. 1, 122-46 (Jan., 1956).

Methods for the preparation of fresh nuclear emulsion for use in the study of cosmic radiation by rocket exposures are described. Shattering and mechanical damage is minimized by substituting transparent plastics for the glass support. By casting the emulsion on a temporary microporous medium such as plaster of Paris, emulsions 2 mm thick can be dried in about six days without appreciable loss of sensitivity. Strong, thin-walled housings for the emulsions are described. The star production rate in emulsions flown in the mesosphere to a peak altitude of 217 km is 1180 ± 280 cm^{-3} per day and is 1.45 ± 0.17 times greater than similar measurements in the stratosphere (30 km). The augmentation of nuclear disintegrations can be accounted for by the opening up of the effective solid angle for star-producing radiation during the rocket flight. Energetic stars with three or more shower particles record with a frequency of 278 ± 30 cm^{-3} per day, about three x greater than in a balloon flight at the same geomagnetic latitude. For large showers $N_S = 6$, the N/P ratio is about 0.17. The observational ratio of M to H nuclei based on a spectrum of 238 heavy primary tracks is 2.6_6. When corrected for fragmentation in surrounding matter this ratio is reduced to 2.5 ± 0.5. The omnidirectional flux of heavy primaries with Z equal or greater than 6 at the top of the atmosphere is 7.62 m^{-2} sec^{-1} sterad^{-1}. An analysis of the zenith angle distribution of the heavy primaries shows that the unidirectional flux is in fair agreement with geomagnetic theory for zenith angles less than 60°. The directional flux for θ greater than 60° is about two times greater than predicted by theory. A.

537.591.1

2219. PRIMARY COSMIC-RAY ALPHA PARTICLES AND PROTONS AT $\lambda = 55°$ N. L.R.Davis, H.M.Caulk and C.Y.Johnson.
Phys. Rev., Vol. 101, No. 2, 800-6 (Jan. 15, 1956).

The intensities of the primary cosmic-ray alpha particles and protons at geomagnetic latitude 55° N are determined from measurements of the ionization and range of the charged cosmic-ray particles observed at atmospheric depths of

8 g/cm² and deeper. The measurements were made with a balloon-borne Geiger-proportional counter telescope which contained absorbers of mercury or lead. Showers of particles in the telescope were detected by out of line counters and eliminated. The particles having residual ranges between 1.5 g/cm² and 43 g/cm² are shown to be secondary electrons and secondary protons. The penetrating particles having range greater than 43 g/cm² divide into singly and doubly charged particles. Extension of the penetrating particle intensity curves to zero depth yields values for the primary intensities of 0.19 (cm² sec sterad)$^{-1}$ for protons and 0.032 (cm² sec sterad)$^{-1}$ for alpha particles. The alpha particles are absorbed exponentially in the atmosphere and the slope of the absorption curve yields the value 35 ± 7 g/cm² for their mean free path in air. Data obtained by removing the absorbers in flight indicate that the net results are free of shower effects. Other systematic uncertainties in the values of the primary intensities are estimated to be $\pm$ 10%, which is larger than the statistical uncertainties. A.

537.591.15

2220. A CLOUD CHAMBER STUDY OF THE COSMIC-RAY HARD SHOWERS. S.Miyake, K.Hinotani and K.Nunogaki.
J. Phys. Soc. Japan, Vol. 11, No. 1, 76-83 (Jan., 1956).

Cosmic-ray hard showers produced in iron and in lead have been studied by using the multiplate cloud chamber at 2740 m above sea level. Primary energies of the meson-producing showers were estimated from the angular and the momentum distributions of the secondaries by various methods and the results were compared with each other. The observed hard showers were classified according to their median angles. About half of the showers which belong to smaller median angle group may be interpreted as having been produced at the periphery of the Pb nuclei. They amount to about 20% of total hard showers. The mean free path for the production of hard showers was obtained as 250 ± 50 g/cm² in lead, and the mean free path of the charge exchange scattering of pions was 1.0 ± 0.3 kg/cm² in lead for energies greater than 1 BeV. A.

537.591.5

2221. EAST-WEST ASYMMETRY OF POSITIVE AND NEGATIVE MESONS AT THE GEOMAGNETIC EQUATOR.
F.B.Harris and I.Escobar V.
Phys. Rev., Vol. 100, No. 1, 255-68 (Oct. 1, 1955).

The intensities of positive and negative μ-mesons at zenith angles of 45° in the east-west plane and at the vertical have been measured at atmospheric depth 548 g.cm^{-2} near the geomagnetic equator. The data are analysed through use of the empirical production spectrum and unidimensional equation for μ-meson production employed by Sands and by Olbert. A careful theoretical discussion is given, taking into account in detail the various effects arising both from the variation of the geomagnetic cutoff with direction of incidence of the primaries and from the curvature of the trajectories of the mesons in the earth's magnetic field after their production in the atmosphere. It is found that, to bring the 45° and vertical data into accord, it is necessary to assume a r.m.s. angle of production of the parent π-mesons of $14^\circ \pm 2^\circ$. It is then possible to express the production spectrum, at any geographical location, by the single equation $G(R') = A[R' + a(M_c)]^{-n}$, where M_c is the cutoff magnetic rigidity for the primaries in a given direction of incidence at that location. The data do not indicate the presence of any appreciable number of negatively charged particles in the primary cosmic radiation. A.

537.591.5

2222. EFFECTS OF A RING CURRENT ON COSMIC RADIATION. E.C.Ray.
Phys. Rev., Vol. 101, No. 3, 1142-8 (Feb. 1, 1956).

A theoretical analysis of the effect of an equatorial ring current on the latitude variation of the primary cosmic radiation has been carried out. It has been found that a ring current of the size suggested by Schmidt should lead to observable effects on the latitude variation. In particular, if a ring current of radius equal to 7.5 earth radii and current strength sufficient to produce a field of 100 γ at the earth's equator exists, then the knee in the latitude variation is a feature of the rigidity cut-off curve rather than of the primary spectrum. The primary spectrum obtained with the use of geomagnetic theory which includes a ring current is satisfactorily fitted with a function of the form $J = 0.29\ E^{-0.9}$ (cm² sec sterad)$^{-1}$, where E is the total energy of a primary particle. Certain features of time variations of the cosmic-ray intensity apparently disagree with the theory. A.

537.591.8

2223. ON THE PROBLEMS OF GENERATION OF PARTICLI SHOWERS BY THE COSMIC RADIATION IN LEAD ABSORBERS OF VARYING THICKNESSES. G.Pfotzer.
Z. Naturforsch., Vol. 10a, No. 9-10, 718-36 (1955). In German.

Some authors measuring transition curves have found further maxima apart from the Rossi maximum, others have not. Experiments are described here which do not yield further maxima although experimental arrangements have been employed which, according to those who have found the extra maxima, ought to be particularly suitable for their discovery. The experimental parameters which might be thought capable of masking the existence of these maxima are discussed in great detail. It is concluded that the reality of these effects must be doubted as well as the hypotheses which have been advanced to explain them. E.W.Kellermann

MAGNETISM 538

538.082 : 531.752

TORSION BALANCE FOR A SINGLE MICROSCOPIC MAGNETIC PARTICLE. See Abstr. 946.

538.114

2224. ON THE HIGH-TEMPERATURE SUSCEPTIBILITY FOR THE HEISENBERG MODEL OF A FERROMAGNET.
G.S.Rushbrooke and P.J.Wood.
Proc. Phys. Soc. A, Vol., 68, Pt 12, 1161-9 (Dec., 1955).

Deals with the high-temperature expansions, in powers of T^{-1}, of the susceptibility, χ, and the inverse susceptibility, χ^{-1}, for the Heisenberg model of a ferromagnet. Expressions valid for any lattice, are given for the coefficients in these expansions, up to and including the coefficient of T^{-5}. The results are discussed numerically, for particular lattices, in their bearing on the Curie temperature. A.

538.114

2225. TEMPERATURE DEPENDENCE OF FERROMAGNETIC ANISOTROPY IN CUBIC CRYSTALS. F.Keffer.
Phys. Rev., Vol. 100, No. 6, 1692-8 (Dec. 15, 1955).

Two theories of the temperature dependence of ferromagnetic anisotropy in cubic crystals, the nearest-neighbour quadrupole-quadrupole coupling theory of Van Vleck, and the more recent classical theory of Zener, seem to be contradictory. It is shown that these theories are, respectively, high- and low-temperature approximations to the same physical picture: namely, an anisotropy which decreases with rising temperature due to statistical fluctuations from alignment of anisotropically-coupled neighbour spins. Zener's low-temperature approximation shows that the anisotropy decreases as the tenth power of the magnetization, Van Vleck's high-temperature approximation yields a lower power law. It is argued that most of the anisotropy has vanished before sufficiently high temperatures are reached for Van Vleck's approximation to be appropriate. Van Vleck's nearest-neighbour

dipole-dipole coupling theory, which has no classical analogue and cannot be compared with Zener's theory, is discussed from a spin-wave picture. A.

538.114

2226. INSTABILITY IN THE MOTION OF FERROMAGNETS AT HIGH MICROWAVE POWER LEVELS. P.W.Anderson and H.Suhl.
Phys. Rev., Vol. 100, No. 6, 1788-9 (Dec. 15, 1955).

Gives an explanation of the ferromagnetic resonance line broadening observed by Bloembergen at power levels low compared with those thought necessary for saturation. The spin precession is shown to become unstable due to the non-linear effect of the demagnetizing field when the radiofrequency field is sufficiently strong. E.P.Wohlfarth

538.13 : 539.319

2227. THE INFLUENCE OF THE INTERNAL STATE ON THE POSITION OF THE POLES IN MAGNETIZED NICKEL WIRE. C.Schwink.
Z. Phys., Vol. 143, No. 2, 205-18 (1955). In German.

The electron optical shadow method of Marton, Simpson and Lachenbruch (Abstr. 2566/1950, 5785/1954), which resembles the optical "schlieren" technique, has been modified in order to investigate the field distribution around magnetized wires of nickel. The influence of the internal state (i.e. strain and texture) on the position of the point poles has been demonstrated; the poles can be located to an accuracy of better than 0.025 mm. In the region of plastic deformation the phenomena can be explained in terms of current theories of the plastic behaviour of polycrystalline metals. For the region of mixed plastic–elastic deformation a model is proposed, resting essentially on the assumption of a surface layer, of thickness approximately 0.03 mm, which is more easily deformable than the internal core. Experiments appear to support this assumption. V.E.Cosslett

538.2

2228. MAGNETS AND MAGNETIC FIELD MEASUREMENTS. A.L.Bloom and M.E.Packard.
Science, Vol. 122, 738-41 (Oct. 21, 1955).

A review of magnet design and field measurement with especial emphasis on large magnets, suitable for nuclear magnetic resonance experiments, with stability and homogeneity both approaching 1 in 10^8. D.H.Whiffen

538.2 : 538.632

2229. SIMPLE EXPERIMENT ON THE HALL EFFECT. J.A.Crawford and D.J.Montgomery.
Amer. J. Phys., Vol. 24, No. 2, 115 (Feb., 1956).

538.22 : 550.382

2230. THE MAGNETIC SUSCEPTIBILITY OF THE SOIL. E.le Borgne.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 20, No. 2, 129-67 (April, 1955). In French.

An examination was made of samples of rocks in regions of France with magnetic anomalies. The magnetic properties of the surface layer of 20-30 cm thick were much more marked than the adjacent mother rocks. Measurements were made mostly with an induction apparatus but some with a magnetometer, of different samples from various components and at different depths to obtain the variation of susceptibility in comparison with the neighbouring mother rocks. Results are quoted for various regions. The susceptibility varies from one soil sample to another but it is higher than for the adjacent mother rock. A granulometric analysis shows that the finest fraction is much more magnetic than others except for soils formed on magnetic sands. When magnetic susceptibility is important the sand component is below 16%. Differences of susceptibility in the surface and lower layers are not due to granulometric composition. An increase of humidity due to water flow produces lower susceptibility and much less than for dry soils. The different fractions separated by granular analysis show an appreciable magnetic viscosity for certain ferruginous combinations and can be used to identify the constituent responsible for the magnetic properties of the soil. The most magnetic fraction is in general the finest, the clay fraction. The behaviour of the magnetic constituent supports the view that it acts as a cubic oxide $Fe_2O_3\gamma$. The formation of this oxide, linked with phenomena of oxy-reduction favoured by fermentation of organic matter, depends upon the conditions of evolution of the soil. A systematic study of susceptibility of the soil can be of use to geologists. Different fractions separated by granular analysis show an appreciable magnetic viscosity for certain ferruginous combinations and can be used in identifying the constituent responsible for the magnetic properties of the soil. R.S.Read

538.221

2231. VARIATION WITH TEMPERATURE OF MAGNETIC PROPERTIES OF NICKEL-ZINC AND COPPER-ZINC FERRITES. A.I.Suchkov.
Zh. tekh. Fiz., Vol. 24, No. 9, 1579-83 (1954). In Russian.

Results of experimental investigations of variation with temperature (from -180° C to $+180^\circ$ C) of a range of nickel-zinc ferrites and copper-zinc ferrites are presented graphically. Magnetic properties of some semiconducting ferrites vary very sharply between -50° C and $+50^\circ$ C. It is shown that the temperature variations of magnetic properties of ferrites and metallic ferromagnetic materials are governed by the same laws. This result is of importance for high-frequency applications of ferrites. J.Lukaszewicz

538.221

2232. THE REDUCED MAGNETIZATION–TEMPERATURE CURVE OF FERROMAGNETIC ALLOYS. J.Kranz and C.Bodewig.
Z. Phys., Vol. 142, No. 4, 396-400 (1955). In German.

The observed deviations of the reduced curves for Ni–Cu alloys from the curve for pure Ni are ascribed to statistical fluctuations in composition. For an alloy with mean Cu concentration C = 0.25 the observed curve is brought into coincidence with that for Ni by assuming a Gaussian distribution with $\sigma = [C(1 - C)/n]^{\frac{1}{2}} = 0.04$, leading to a value for the number of atoms n in a region of constant composition (erroneously called a domain) equal to only 120. E.P.Wohlfarth

538.221

2233. THE DAMPING OF IRON–NICKEL ALLOYS. R.Ochsenfeld.
Z. Phys., Vol. 143, No. 3, 357-73 (1955). In German.

Reports results of measurements of the logarithmic decrement of Fe–Ni strips, with Ni contents between 0 and 60%, performing flexural oscillations, as dependent on the frequency (200-1300 c/s), the strain amplitude and the applied field strength. The various contributions to the damping mechanism (magnetic and magnetomechanical hysteresis, macroscopic and microscopic eddy currents) are discussed. E.P.Wohlfarth

538.221

2234. THE MAGNETO-ELASTIC PROPERTIES OF SOME FERROMAGNETIC IRON–NICKEL ALLOYS. R.Ochsenfeld.
Z. Phys., Vol. 143, No. 4, 375-91 (1955). In German.

The ΔE effect is shown to be affected by the application of the external forces during the measurement of Young's modulus and, since these cause some demagnetization of the specimen, the total ΔE measured is not the "true" effect which depends only on the state of magnetization in the applied field. Furthermore, the effect also depends on the strain amplitude, so that Hooke's law is not obeyed even for small values of the amplitude. This effect is suggested to be due to magnetomechanical hysteresis. The non-Hookean range can be reduced by application of an external magnetic field, and the transition to normal Hookean behaviour is shown to take place spontaneously. E.P.Wohlfarth

538.221

2235. EFFECT OF SHAPE ANISTROPY ON THE COERCIVE FORCE OF ELONGATED SINGLE-MAGNETIC-DOMAIN IRON PARTICLES. T.O.Paine, L.I.Mendelsohn and F.E.Luborsky.
Phys. Rev., Vol.100, No. 4, 1055-9 (Nov. 15, 1955).

Elongated single-magnetic-domain iron particles, 150 angstrom units in diameter, have been prepared with properties that definitely confirm the existence of a shape anistropy effect on coercive force. This conclusion is based upon four observations: (1) Torque curve analysis shows the predominating anistropy effect to be uniaxial. (2) With increasing particle elongation, the temperature coefficient of coercive force departs from the temperature coefficient of crystal anisotropy and approached the temperature coefficient of saturation induction. (3) Coercive forces greater than 2000 oersted for iron have been measured. (4) A direct correlation is observed between particle coercive force and elongation. A.

538.221

2236. AN APPROACH TO ELONGATED FINE-PARTICLE MAGNETS. I.S.Jacobs and C.P.Bean.
Phys. Rev., Vol. 100, No. 4, 1060-7 (Nov. 15, 1955).

The coercive force predicted by theory for single-domain particles with shape anisotropy frequently far exceeds the observed value. From an examination of the results of Paine, Mendelsohn and Luborsky (preceding abstract) on elongated iron particles, several approximate models are suggested which may exist in certain experimental situations. Detailed calculations are presented for a "chain-of-spheres" model remagnetizing by several mechanisms. Comparison with experiment on certain single-domain particles of known elongation favours the chain-of-spheres model as a suitable description of their magnetic behaviour. A successful calculation is made of the coercive force of material prepared by several earlier workers. A comparison of the new models with the older ones indicates a direction for experimental advance. A.

538.221

2237. ON THE MEASUREMENT OF THE MAGNETIC PERMEABILITY OF METALS BY MEANS OF A CAVITY RESONATOR AND THE PERMEABILITY OF IRON IN THE REGION OF FERROMAGNETIC RESONANCE. II.
K.H.Reich.
Frequenz, Vol. 9, No. 12, 414-22 (Dec., 1955). In German.

For Pt I see Abstr. 471/1956. A brief review of available methods of permeability measurement in the frequency range from 100 Mc/s to 3 Gc/s, followed by a detailed account of a cavity resonator method. The application of the method to the measurement of the permeability of iron as a function of field strength is discussed. Sources of error are considered and suggestions made for improving the method.
A.E De Barr

538.221

2238. FERROMAGNETIC RESONANCE IN MANGANESE FERRITE SINGLE CRYSTALS. P.E.Tannenwald.
Phys. Rev., Vol. 100, No. 6, 1713-19 (Dec. 15, 1955).

The microwave properties of two types of manganese ferrite single crystals have been investigated by means of the ferromagnetic resonance phenomenon from 300°K to 4.2°K and at 24 000, 9100, 5600 and 2800 Mc/s. The low resistivity of one of the crystals, believed to be related to the presence of divalent iron, led to significantly different microwave behaviour. Resonance lines as narrow as 47 Oe have been obtained; however the width depends markedly on crystal direction, temperature and microwave frequency. The g-values are close to 2.00 under all conditions. The anisotropy, although frequency insensitive, increases rapidly at low temperatures. The Kramers–Krönig relations between absorption and dispersion are satisfied, and the line shape is roughly Lorentzian. Double resonances have been observed, and it is speculated that this may be a general phenomenon in single-crystal ferrites under suitable conditions. A.

538.221

2239. ANTIFERROMAGNETIC STRUCTURE OF α-MANGANESE AND A MAGNETIC STRUCTURE STUDY OF β-MANGANESE. J.S.Kasper and B.W.Roberts.
Phys. Rev., Vol. 101, No. 2, 537-44 (Jan. 15, 1956).

Neutron diffraction data have been obtained at 4.2°K and 298°K for both α-Mn and β-Mn. The pattern of moment alignment in the antiferromagnetic state of α-Mn is deduced. Dependent on interatomic distance, both parallel and antiparallel spin couplings are present. Also, for one kind of atom no moment alignment occurs. The magnitudes of the individual moments appear to exceed considerably one Bohr magneton. No coherent magnetic scattering is detectable for β-Mn at 4.2°K. The effect of atomic separation and of atomic arrangement on magnetic structure is discussed. A.

538.221 : 538.652

2240. CALCULATION OF MAGNETOSTRICTION CONSTANTS FOR NICKEL. G.C.Fletcher.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1066-71 (Nov., 1955).

Calculations are made of the magnetostriction constants λ_{100} and λ_{111} for nickel at 0°K, based on the collective electron model and the calculations of the author of the N(E) curve for the 3d electrons in that metal. The values of -187×10^{-6} and -44×10^{-6} obtained for λ_{100} and λ_{111} respectively are both rather larger than the latest experimental figures which, however, are available only for 120°K. The method of calculation is very similar to that used by the author in previous work on ferromagnetic anisotropy and the possible reasons for discrepancy between theory and experiment are also similar. A.

538.222

2241. A HYPERFREQUENCY SPECTROGRAPH OF THE AUTODYNE TYPE FOR THE STUDY OF DISPERSION IN ELECTRON MAGNETIC RESONANCE. J.Hervé.
C.R. Acad. Sci. (Paris), Vol. 241, No. 13, 794-5 (Sept. 26, 1955). In French.

A microwave klystron is locked in frequency to a cavity with a Pound stabilizer. The reflector voltage is a measure of the cavity resonance frequency and its variation may be displayed on an oscilloscope. If the cavity contains the free radical diphenyl picryl hydrazyl at resonance, the oscilloscope displays the dispersion of its magnetic susceptibility when the time base is synchronized with the small magnetic field modulation. D.H.Whiffen

538.222

2242. DOUBLE-FREQUENCY MAGNETIC RESONANCE IN A FREE RADICAL. J.H.Burgess and R.E.Norberg.
Phys. Rev., Vol. 100, No. 2, 752-3 (Oct. 15, 1955).

In the presence of an intense r.f. field at about 27 Mc/s = ν_s, which can saturate one resonance b → c of aqueous $ON(SO_3)_2^=$, the weak-field detection of a second transition a → b near 40 Mc/s = ν_d shows an asymmetrical shape as a function of the static magnetic field, 20 to 25 gauss, and may even show a clear resolved peak when $\nu_s + \nu_d$ has the exact value required for the a → c transition. The variation of position and intensity as a function of ν_s are in agreement with the theory. D.H.Whiffen

538.222

2243. MAGNETIC SUSCEPTIBILITY OF RED PERCHROMATES OF MAGNESIUM AND POTASSIUM. B.R.Rios and J.Hoarau.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1299-301 (Nov. 7, 1955). In French.

From magnetic measurements on $KMgCrO_8.7\frac{1}{2}H_2O$ and K_3CrO_8 using a Weiss–Foex–Forrer magnetic balance, the

chromium in these compounds is shown to be pentavalent, the observed paramagnetism indicating the presence of an unpaired electron. G.I.W.Llewelyn

538.222

2244. SPIN RESONANCE LINE SHAPE. J.I.Kaplan.
Amer. J. Phys., Vol. 23, No. 9, 585-8 (Dec., 1955).

A method is given for the calculation of the spin resonance equations based on solving for the spin vector expectation value subject to several external conditions. The value of the method is limited to the case where the sustem can be described by one relaxation time. A.

538.222

2245. THE IMPROVEMENT OF A PARAMAGNETIC ELECTRON RESONANCE SPECTROGRAPH. APPLICATION TO THE STUDY OF DIPHENYL PICRYL HYDRAZYL. G.Berthet.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1730-3 (Dec. 14, 1955). In French.

Increase of klystron power from 30 mW to 3 W improved the sensitivity of detection of the electron resonance of diphenyl picryl hydrazyl by nine times. D.H.Whiffen

538.222

2246. $\Delta M = \pm 2$ TRANSITIONS IN DILUTE GADOLINIUM ETHYL SULPHATE. H.A.Buckmaster.
Canad. J. Phys., Vol. 34, No. 1, 150-1 (Jan., 1956).

538.222

2247. PARAMAGNETIC RESONANCE ABSORPTION IN DIPHENYLPICRYLHYDRAZYL. R.Livingston and H.Zeldes.
J. chem. Phys., Vol. 24, No. 1, 170-1 (Jan., 1956).

Reports a line width anisotropy in the paramagnetic electron resonance of a single crystal of diphenyl picryl hydrazyl as the crystal was rotated. D.H.Whiffen

538.222 : 621.318.3

2248. PRODUCTION OF VERY HOMOGENEOUS MAGNETIC FIELDS FOR THE STUDY OF FINE STRUCTURE IN NUCLEAR PARAMAGNETIC RESONANCE. J.Pontier.
Onde élect., Vol. 35, 481-4 (May, 1955). In French.

An air-cored Helmholtz coil system, the field at the centre being 39.4 G/A and the maximum field about 700 G. The field on and near the axis is calculated and, over a volume of 0.5 cm^3, is claimed to be homogeneous to 1 part in 10^8. Equipment for field calibration by paramagnetic resonance is also described. A.E.De Barr

538.24

2249. SOME BOUNDARY PROBLEMS OF THE THEORY OF IMPULSIVE MAGNETIZATION. I.M.Taksar and Z.Ya.Plume.
Trudy Inst. Fiz. Akad. Nauk Latv. USSR, Vol. 6, 21-38 (1953). In Russian.

A study is made of the problem of longitudinal magnetization of an infinite, circularly cylindrical, conducting wire of unit radius by the application of an external magnetic field. Two cases of external field are considered: in one the field jumps from zero to unity at time $t = 0$, while in the other the value unity is approached exponentially. The problem is solved by separation of variables. Mathematical Reviews

538.24

2250. THE BARKHAUSEN EFFECT. R.S.Tebble.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1017-32 (Dec., 1955).

A critical examination is made of the elementary processes which are usually considered as responsible for the discontinuous and irreversible domain boundary movements associated with the Barkhausen effect. The domain structure of an iron-like crystal is considered and it is shown that, of the processes investigated, the only mechanism which will produce discontinuities of the observed order of magnitude and which will result in a hysteresis curve of the usual type, is one in which the movement of a limited section of a 180^0 domain boundary is delayed by a non-magnetic inclusion whose cross-sectional dimensions are of the same order as the boundary thickness and lie within the range 1 to 2×10^{-5} cm. Inclusions below a critical size (about 10^{-5} cm) will be associated only with reversible effects; the energy associated with larger inclusions (greater than 10^{-4} cm) will be reduced by the presence of subsidiary domain structures and the associated discontinuous boundary movements will be negligibly small. An explanation of the general form of the experimental results is given and it is suggested that any reduction in the hysteresis loss in ferromagnetic materials can best be brought about by the selective reduction of the number of inclusions whose size is within the critical range. A.

538.245 : 538.665

2251. THE THERMAL EFFECTS ASSOCIATED WITH THE MAGNETIZATION OF HIGH-COERCIVITY MATERIALS.
L.F.Bates and A.W.Simpson.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 849-58 (Nov., 1955).

The heat changes accompanying magnetization processes in materials of high coercivity, over a field range of 4000 oersteds, have been studied by a new method. The results are in good agreement with the Stoner and Rhodes theory of magnetization processes in such materials. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

2252. ON DERIVING THE FORMULAS FOR ELECTROMAGNETIC AND OTHER FORCES FROM THE INTERACTION ENERGY OF THE FIELDS. H.L.Armstrong.
Amer. J. Phys., Vol. 23, No. 9, 582-4 (Dec., 1955).

A treatment of some force and energy relations of electromagnetic theory is given, in which the energy density of the field is postulated as fundamental, and the force relations are derived by transformations of vector integrals. This focuses attention on the fields as the concepts of especial interest; the attention to interaction energies of fields offers interesting analogies to the methods used in wave mechanics. A.

538.3 : 621.3.011

2253. ON THE AMPÈRE FORCE. P.Moon and D.E.Spencer.
J. Franklin Inst., Vol. 260, No. 4, 295-311 (Oct., 1955).

In an earlier paper (see Abstr. 8439/1954) an attempt was made to prove that a certain equation for the force between unaccelerated charges is the only one consistent with accepted ideas on metallic conduction. An error was detected in the reasoning and it is now shown that the correction to the error is of no practical significance. Predictions of the new electrodynamics are compared with classical results.

L.S.Goddard (R)

538.522

2254. THE INDUCTANCE OF TWO ELLIPTIC TUBES
E.E.Jones.
Brit. J. appl. Phys., Vol. 7, No. 2, 56-8 (Feb., 1956).

The magnetic field of two conducting tubes of non-magnetic material is determined in terms of certain vector potential components. Each tube forms the annulus between two successive elliptic cylinders of the same confocal system, and equal and opposite steady currents flow along them. The inductance of the system is determined in terms of its geometry and some numerical results are recorded. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

2255. MAGNETOHYDRODYNAMIC OSCILLATIONS IN A ROTATING, ELECTRICALLY CONDUCTING, ELLIPSOIDAL LIQUID MASS. T.Zeuli.
Atti Accad. Sci. Torino I, Vol. 89, Disp. 2, 270-85 (1954-55). In Italian.

Extension to a three-axes ellipsoid of results obtained by Agostinelli (Abstr. 8088-9/1955) for the case of a rotation ellipsoid. L.Pincherle

538.566

2256. REFLECTION OF AN ELECTROMAGNETIC PLANE WAVE IN A STRATIFIED IONIZED GAS. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1272-5 (Nov. 7, 1955). In French.

An ionized gas whose refractive index is constant below a certain level but dependent upon position above it is studied and an expression obtained for the group propagation time through the medium. A.J.Egginton

538.566 : 538.61

2257. A STUDY AT 10 000 Mc/s OF THE FARADAY EFFECT IN A PLASMA. M.Bonnet, M.Matricon and E.Roubine.
Ann. Telecomm., Vol. 10, No. 7-8, 150-8 (July-Aug., 1955). In French.

A simplified theory of the effect is given, which, however, is difficult to test numerically. An experimental arrangement is described. Neon plasmas were studied at 3.2 cm wavelength and the rotation was measured as a function of magnetic field and discharge current, rotations of up to 250° being observed. The apparatus did not allow the magnetic field for gyromagnetic resonance to be reached. A.H.W.Beck

538.566

2258. ON THE PROPER FREQUENCIES OF TERMINATED CORRUGATED WAVEGUIDES WITH SLIGHTLY DIFFERENT DIAMETERS. V.J.Vanhuyse.
Physica, Vol. 21, No. 7, 603 (July, 1955).

It is shown that a change in diameter of a cavity forming part of a corrugated waveguide can be accounted for by the use of standard perturbation technique. The frequency equations derived in Abstr. 5529 (1955) are shown to have a wider validity than was supposed therein. G.D.Sims

538.566

2259. MULTIPOLES AND SCHELKUNOFF WAVES. THE GENERAL CASE. I.Ferrari.
R.C. Accad. Naz. Lincei, Vol. 18, No. 6, 623-30 (June, 1955). In Italian.

See Abstr. 4820 (1955). The field of every Schelkunoff wave is a linear combination of fields of suitably arranged multipoles. The coefficients of such combinations are calculated for the most general case. L.Pincherle

538.566

2260. RADIATION RESISTANCE OF DIPOLES IN AN INTERFACE BETWEEN TWO DIELECTRICS. J.R.Wait.
Canad. J. Phys., Vol. 34, No. 1, 24-6 (Jan., 1956).

Exact expressions are derived for the radiation resistance of electric and magnetic dipoles located in the plane interface between two semi-infinite losslees dielectrics. A.

538.566.2 : 621.396.677.08

2261. THE DEPENDENCE OF METEORIC FORWARD-SCATTERING ON ANTENNA PATTERNS AND ORIENTATIONS. C.O.Hines, P.A.Forsyth, E.L.Vogan and R.E.Pugh.
Canad. J. Phys., Vol. 33, No. 10, 609-10 (Oct., 1955).

It is shown that non-specular reflection of radiowaves from random blobs of ionospheric ionization is important for highly-directional aerials beamed over the transmitter–receiver axis, whereas meteoric scattering is important for broad-beamed aerials, or directional aerials beamed to one side of the TR axis. M.W.Ovenden (R)

538.567 : 537.562

2262. INTERACTION OF ELECTROMAGNETIC WAVES OF RADIO-FREQUENCY IN ISOTHERMAL PLASMAS: COLLISION CROSS SECTION OF HELIUM ATOMS AND IONS FOR ELECTRONS. J.M.Anderson and L.Goldstein.
Phys. Rev., Vol. 100, No. 4, 1037-46 (Nov. 15, 1955).

The elements of the theory of interaction of radio-frequency electromagnetic waves in gaseous discharge plasmas are reviewed. The applicability of this phenomenon of wave interaction to the measurement of quantities involved in fundamental processes in such plasmas is considered. A measurement of the "effective" electron–atom collision frequency in helium, found to be 3.12×10^8/sec/mmHg for room-temperature electrons (about 300°K), gives a value for the probability of collision for momentum transfer, P_m, of the helium atom equal to 24.0 cm²/cm³ at 0°C and 1 mm Hg. An experimental determination of the "effective" electron–ion collision frequency (for singly charge ions) has also been determined which closely agrees with earlier theoretical predictions. The ratio of the effective cross-sections, associated with electron collisions, of ions and helium atoms in the room-temperature isothermal plasma is about 3.0×10^5 at an ion density of 10^{11}/cm³. A.

MOLECULAR AND ATOMIC STRUCTURE 539.1

539.1

2263. THOMAS–FERMI MODEL OF COMPRESSED ATOMS. R.Latter.
J. chem. Phys., Vol. 24, No. 2, 280-92 (Feb., 1956).

Solutions of the zero-temperature Thomas–Fermi equation for an atomic system have been obtained by numerical integration with the aid of the IBM 701 Calculator. The complete range of atomic volumes of physical interest has been covered in sufficient detail to permit accurate interpolation to intermediate regions. Tables of the potential distributions are given as well as of the important physical properties. A.

THEORY OF SOLID STATE 539.11

539.11

2264. THE DIELECTRIC THEORY OF ELECTRONIC INTERACTIONS IN SOLIDS. J.Hubbard.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 976-86 (Nov., 1955).

It is suggested that the long-range part of the Coulomb interaction of the electrons in solids can be treated by regarding the solid as a homogeneous dielectric. The theory is developed in a semi-classical way. It is found that there is a possibility of sustained electric oscillations in metals, and these are identified in the case of a free electron gas with the plasma oscillations of Bohm and Pines. The theory is used to discuss the plasma frequencies of metals and the energy loss spectra of fast electrons in Ruthemann and Lang type experiments. The connection with the optical properties is indicated. A.

539.11 : 539.219

2265. THE BINDING ENERGY OF NITROGEN IN A DISLOCATION. W.R.Thomas and G.M.Leak.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1001-7 (Dec., 1955).

The solubility of interstitially dissolved nitrogen has been measured both in annealed and in cold-worked alpha iron by

the internal friction technique in more detail than in the original work of Dijkstra. The dissolved nitrogen in annealed material, in equilibrium with a precipitated nitride, has a heat of solution of 0.26 eV per nitrogen atom. This agrees reasonably well with other published values. A new approach has been introduced into the treatment of the results for the solubility of nitrogen in cold-worked iron. Equilibrium is considered between nitrogen atoms in free solution and nitrogen atoms bound in dislocation sites. Since the number of dislocation sites is fixed, account is taken of the proportion of these occupied at different temperatures. The value for the binding energy of nitrogen atoms in dislocation sites is estimated as lying between 0.75 and 0.8 eV per nitrogen atom. A.

539.11

2266. COUPLING FORCES BETWEEN METAL ATOMS. W.Brenig.
Z. Phys., Vol. 142, No. 2, 163-81 (1955). In German.

Rigorous quantum mechanical expressions are derived for the forces between atoms in a solid. The dependence of the electron density on the displacement of a single atom from its equilibrium position is the only quantity to be calculated quantum mechanically. This is done approximately for monovalent metals. It appears that coupling up to 3rd order neighbours is important. Comparisons with experimentally (from thermal scattering of X-rays) determined coupling constants for Cu indicate an unexpectedly large contribution to the interaction from the completed 3d shells. F.Ansbacher

539.11

2267. THE FREE-ELECTRON NETWORK MODEL FOR METALS. II. C.A.Coulson.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1129-35 (Dec., 1955).

For Pt I, see Abstr. 9433/1954. The free electron network model for metals originally introduced by the writer is extended in two ways. First an allowance is made for the strong electron attraction towards the nuclei by inserting δ-function potential wells at the positions of these nuclei. Secondly, the potential between the nuclei is not regarded as constant but may be of arbitrary shape. Provided that this potential does not fluctuate too fast along the 'bonds', its influence on band shape is shown to be small, in agreement with the situation found without δ-functions by Raychaudhuri. Atoms of different kinds may be introduced into the lattice, and the particular cases of the diatomic cubic lattice AB and the planar hexagonal lattice of graphite type (example, boron nitride) are studied in detail. A possible application to the problem of antiferromagnetism is pointed out, involving a splitting of one otherwise continuous energy band into two separated parts as a result of partial localization of electrons of similar spin on alternate atoms. A.

539.11 : 538.632

2268. THE HALL EFFECT IN METALS AT HIGH FREQUENCIES. B.Donovan.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1026-32 (Nov., 1955).

The theory of the Hall effect at high frequencies is developed in terms of the "surface Hall coefficient" defined in a similar manner to the complex surface impedance for metals. Calculations of this coefficient have been carried through for a metal with two overlapping energy bands, and the variations with frequency and with field strength are shown graphically for certain special cases. At very low frequencies the Hall coefficient is constant at the d.c. value; at higher frequencies it increases as the square root of the frequency and ultimately, in the infrared region for normal metals, attains a limiting value independent of frequency. Furthermore a phase difference exists in general between the Hall field and the specimen current but this decreases to zero at very low and very high frequencies. A.

539.11 : 548.7

2269. POSSIBILITY OF A ZENER EFFECT. G.H.Wannier.
Phys. Rev., Vol. 100, No. 4, 1227 (Nov. 15, 1955).

At high electric fields the band structure in crystals is modified and smooth acceleration of electrons from band to band becomes possible. The Zener effect is thus replaced by a model in which no conduction occurs below a threshold field but above this field conduction is metallic. Lattice defects will perturb this condition and a Zener effect becomes possible. G.F.J.Garlick

539.11 : 548.74

2270. NEUTRON SCATTERING AND THE FREQUENCY DISTRIBUTION OF THE NORMAL MODES OF VANADIUM METAL. B.N.Brockhouse.
Canad. J. Phys., Vol. 33, No. 12, 889-91 (Dec., 1955).

Preliminary measurements of neutrons scattered both elastically and inelastically by vanadium at different temperatures are consistent with a Debye model for this metal. It is hoped by using improved techniques to obtain the essential features of the frequency distribution. J.Thewlis

MOLECULES 539.13

539.13

2271. PI-ELECTRON FORCES BETWEEN CONJUGATED DOUBLE BOND MOLECULES. E.F.Haugh and J.O.Hirschfelder.
J. chem. Phys., Vol. 23, No. 10, 1778-96 (Oct., 1955).

The long-range forces between large conjugated double bond molecules are highly directional and anomalously strong. This is the result of π electrons moving freely from one end of the conjugated double bond system to the other, making the molecule behave like an extended oscillator. All three types of dispersion forces: $\sigma\sigma$, $\sigma\pi$ and $\pi\pi$ are calculated for ethylene, acetylene and the higher polyenes. In addition the $\pi\pi$ interaction energy is calculated for benzene. The free electron molecular orbitals are used for the π electrons and products of these orbitals are approximated by "transition monopoles". The treatment of the σ electrons and the use of the transition monopoles were suggested by London. The resulting energies are easy to calculate and easy to interpret. The $\pi\pi$ energy is proportional to the square of the energy of interaction of two real transition dipoles (real in the sense of the monopoles being separated by a finite distance). Previously, Coulson and Davies calculated the $\pi\pi$ interaction energy using LCAO orbitals and evaluating all integrals accurately; however, because of the complicated nature of their calculations it was not possible for them to obtain a simple understanding of the variation of the energy with the orientations of the molecules. The values obtained for the $\pi\pi$ energy agree with those of Coulson and Davies except for a scale factor, the present results being uniformly $\frac{3}{5}$ smaller. Such a scale factor corresponds to an adjustable parameter in either the Coulson and Davies treatment or the author's. The $\sigma\pi$ interaction energy has never previously been considered. For long polyenes, for which a simplified treatment is given, the $\pi\pi$ energy is larger than the $\sigma\pi$ which is larger than that of the $\sigma\sigma$. In the appendix, the free electron model is used to calculate the pi-electron contribution to the polarizability and excellent agreement is obtained with the LCAO calculations of Davies. A.

539.13

2272. CALCULATION OF INTERACTION POTENTIALS FROM SCATTERING CROSS SECTIONS. E.A.Mason.
J. chem. Phys., Vol. 23, No. 12, 2457 (Dec., 1955).

The method given by Myers (Abstr. 5550/1955) is improved to yield accurate potential parameters, by including the terms arising from the potential energy of beam and scattering par-

ticle at the distance of closest approach. As an example H^+ scattered in He is considered. J.Jacobs

539.13 : 539.132

2273. STUDIES OF THE INTERACTION BETWEEN ATOMS AND STABLE MOLECULES. VI. THE INTERACTION OF A Be ATOM WITH AN H_2 MOLECULE. V.Griffing, J.P.Hoare and J.T.Vanderslice.
J. chem. Phys., Vol. 24, No. 1, 70-6 (Jan., 1956).

For Pt V, see Abstr. 6349 (1955). A molecular orbital approach has been made to the reaction between a Be atom and an H_2 molecule. Two reactions have been considered: (1) $Be + H_2 \rightarrow BeH_2$; (2) $Be + \frac{1}{2}H_2 \rightarrow BeH$. Correlation diagrams have been constructed following the general rules developed in the previous papers of this series. LCAO-SCF calculations have confirmed the conclusions drawn from the correlation diagram of reaction. Theory and experiment have been found to be in qualitative agreement. A.

539.132 : 539.11

2274. THEORY OF THE ORTHO–PARA CONVERSION IN SOLID HYDROGEN. K.Motizuki and T.Nagamiya.
J. Phys. Soc. Japan, Vol. 11, No. 2, 93-104 (Feb., 1956).

The rate of ortho–para conversion in solid hydrogen (H_2) is calculated, taking two kinds of interactions between ortho-molecules into consideration: interaction between the nuclear spins of one molecule and those of the other molecule and interaction between the rotational magnetic moment of one molecule and the nuclear spins of the other molecule. When an ortho-molecule converts into a para-molecule, the rotational energy of the former is emitted as lattice phonons; the Debye model is taken for the lattice vibrations and it is found that the dominant process is the emission of two phonons. The result for the rate of conversion (including a small effect arising from the emission of three phonons) is 1.94% per hour, which is comparable with the observed value of 1.75% per hour due to Cremer and of 0.9% per hour obtained recently by Hill. Further, the effect of a small amount of oxygen dissolved in solid hydrogen is treated and curves for the increase in average concentration as functions of time are plotted for various values of the oxygen concentration and of the initial ortho concentration. A.

539.132

2275. DETERMINATION OF THE STRUCTURE OF THE DISTENDED MOLECULE FROM THE ENERGY MINIMUM K.Artmann.
Z.Phys., Vol. 142, No. 5, 518-43 (1955). In German.

The central atom theory is developed to a complete molecule theory, by searching for the directions of the outer atoms in which the molecular energy assumes its lowest value. If unperturbed wave functions are used for the central atom the method resembles that of Heitler–Rumer. However since four-fold exchange integrals between central and outer atoms are taken into account, directed valence is obtained. It is maintained that such directed valence can only be dealt with in the extended molecule. J.Jacobs

539.132

2276. THE FUNDAMENTAL FREQUENCIES OF CALCITE WHICH ARE ACTIVE IN ABSORPTION. J.Louisfert.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 940-2 (Oct. 10, 1955). In French.

The fundamental frequencies have been determined at 319 (E_u), 338 (A_{2u}), 712 (E_u), 860 (A_{2u}), 1430 (E_u) using a series of Perkin–Elmer spectrographs. In the interpretation of the 1350-1500 cm^{-1} region, Fermi resonance fixed the E_u internal vibration of the $CO_3^=$ ion at 1430 cm^{-1}. J.Jacobs

539.132

2277. ROTATIONAL ANALYSIS OF BANDS OF THE $A^3\Pi_{0^+}$, $B^3\Pi_1 - X^1\Sigma^+$ SYSTEMS OF INDIUM MONOFLUORIDE. R.F.Barrow, D.V.Glaser and P.B.Zeeman.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 962-8 (Nov., 1955).

A rotational analysis has been made of the 1, 0, 0, 0, 0, 1 and 1, 2 bands of the A–X system and of the 1, 0 0, 0 and 0, 1 bands of the B–X system of InF. Two branches are found in the A–X bands, and three in the B–X bands, confirming the identification of A as $^3\Pi_{0^+}$ and B as $^3\Pi_1$. The internuclear distance in the ground state, r_e'' is 1.985 A. A.

539.132

2278. CALCULATED VIBRATIONAL FREQUENCIES FOR BROMOSILANES. H.Murata and K.Kawai.
J. chem. Phys., Vol. 23, No. 12, 2451-2 (Dec., 1955).

Frequencies calculated for SiH_nBr_{4-n} by the method of Abstr. 4105 (1949) agree well with experiment. J.Hawgood

539.132

2279. VIBRATIONAL ASSIGNMENT FOR SODIUM ACETATE. K.J.Wilmshurst.
J. chem. Phys., Vol. 23, No. 12, 2463 (Dec., 1955).

The Raman and infrared spectra have been measured: assignments agree with those of Abstr. 844 (1955) except in the region 1300-1500 cm^{-1}. The CH_3 symmetrical bending frequency is assigned to 1341 instead of 1425, using comparisons with this frequency in methyl halides and nitromethane: other frequencies are re-assigned to fit in with this. J.Hawgood

539.132

2280. HINDERED ROTATION IN ORGANIC MOLECULES. THERMODYNAMIC SIDE OF THE QUESTION. A.Pacault and P.Bothorel.
Bull. Soc. Chim. France, 1956, No. 1, 217-29 (Jan.) In French.

After a short historical introduction, the thermodynamic theory of the hindered rotation is given, starting from the Schrödinger equation, taking $V = (Vo/2)(1 - \cos \tau\phi_i)$. Vo, the potential barrier opposing free rotation can be calculated via entropy, specific heat or equilibrium constant. As an example the classical and statistical entropy of styrene are calculated, and from the difference Vo is found to be 2.8 kcal/mol. 119 refs. C.Turner

539.132

2281. SELECTION RULES FOR A FREELY ROTATING ETHANE-TYPE MOLECULE. R.P.Bauman.
J. chem. Phys., Vol. 24, No. 1, 13-15 (Jan., 1956).

Recent investigations of dimethyl acetylene and perfluorodimethyl acetylene have suggested that the selection rules for a freely rotating ethane-type molecule should be those of the point group D_{3d} rather than D_{3h}. A demonstration that this holds under the usual Born–Oppenheimer approximation is given. Possible deviations from this in any particular case should depend upon the characteristics of the individual molecule. A.

539.132

2282. INFRARED SPECTRUM AND MOLECULAR CONSTANTS OF CARBON DIOXIDE. I. ν_2 OF $C^{12}O_2^{16}$ AT 15 μ. K.Rossmann, K.Narahari Rao and H.H.Nielsen.
J. chem. Phys., Vol. 24, No. 1, 103-5 (Jan., 1956).

The vibration–rotation band associated with the fundamental bending vibration of CO_2 has been reinvestigated with a 2000 lines-inch grating mounted in a vacuum chamber. The P and R structure has been resolved up to J = 60. The molecular constants have been evaluated and are summarized in a table. Within the accuracy of the present data it has not been possible to detect any change in the centrifugal stretching constants between the two states involved in this transition. A.

539.132

2283. DETERMINATION OF THE POTENTIAL CONSTANTS OF OZONE FROM CENTRIFUGAL DISTORTION EFFECTS. L.Pierce.

J. chem Phys., Vol. 24, No. 1, 139-42 (Jan., 1956).

The microwave spectrum of O_3 was reanalysed to include the effect of centrifugal distortion. Using the Kivelson–Wilson energy expression for a semirigid rotor it was possible to fit eighteen rotational lines to within a mean deviation of $\pm$ 1.4 Mc/s. The rotational constants determined in this manner are a = 106 534.74 Mc/s, b = 13 348.95 Mc/s. The four distortion constants predicted vibrational frequencies which differed by only 4% from the observed values. A sensitive determination of the potential function was made by requiring it be compatible with both the observed infrared spectrum and the distortion frequency shifts derived from the direct analysis of the rotational spectrum. The resulting force constants are: $f_d = 5.70 \times 10^5$ dyne cm^{-1}, $f_\alpha/d_o^2 = 1.28 \times 10^5$ dyne cm^{-1}, $f_{d\alpha}/d_o = 0.332 \times 10^5$ dyne cm^{-1}, $f_{dd} = 1.52 \times 10^5$ dyne cm^{-1}. The force constants were then used to calculate distortion constants for $O^{16}O^{18}O^{16}$ and these in turn were used to analyse its rotational spectrum. A.

539.132

2284. NITRIC OXIDE FUNDAMENTAL. J.H.Shaw.
J. chem. Phys., Vol. 24, No. 2, 399-402 (Feb., 1956)

The 5.3 micron rotation-vibration band of NO has been reexamined with a high resolution spectrometer. A set of constants has been determined which is in good agreement with existing data. A.

539.132 : 535.343

SPECTRUM AND DISSOCIATION ENERGY OF BrF.
See Abstr. 1061.

539.132

2285. THE STUDY OF BUTADIENE BY THE METHOD OF "ATOMS IN MOLECULES". A.Pullman and H.Berthod.
J. Chim. phys., Vol. 52, No. 10, 771-4 (1955). In French.

Using Moffitt's correction, the transition energies after configuration interaction are determined as $N \rightarrow V_1 = 5.7$ eV; $N \rightarrow V_2 = 6.4$ eV; but the method gives an exaggerated polarity for the ground state. J.Jacobs

539.132

2286. CALCULATION OF TRANSITION MOMENTS OF HARMONIC BANDS OF A DIATOMIC MOLECULE AS A FUNCTION OF ANHARMONICITY CONSTANTS. I.Gamo.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1557-8 (Nov. 28, 1955). In French.

Transition moments have been evaluated from wave functions corrected to first-order perturbations. Harmonics higher than the 9th cannot be observed if one ignores transitions other than from the ground state. J.Jacobs

539.132 : 535.343

2287. FORBIDDEN TRANSITIONS IN DIATOMIC MOLECULES. IV. THE $a'^3\Sigma^+ \leftarrow X^1\Sigma^+$ AND $e^3\Sigma^- \leftarrow X^1\Sigma^+$ ABSORPTION BANDS OF CARBON MONOXIDE. G.Herzberg and T.J.Hugo.
Canad. J. Phys., Vol. 33, No. 12, 757-72 (Dec., 1955).

For Pt III, see Abstr. 4948 (1953). Two examples of forbidden electronic transitions in heteronuclear molecules, $^3\Sigma^+ - ^1\Sigma^+$ and $^3\Sigma^- - ^1\Sigma^+$, were studied in the spectrum of the CO molecule. The bands were obtained in absorption in the region 1750 to 1230 A with absorbing paths up to 400 cm-atm., using the fourth and fifth orders of a 3 m vacuum spectrograph. In most of the $^3\Sigma^+ - ^1\Sigma^+$ bands all four predicted branches were observed. For the $^3\Sigma^- - ^1\Sigma^+$ bands, a somewhat unusual structure is predicted: two branches of O and S form and three branches of Q form. In the best-resolved bands, four branches were observed which closely fit the predicted branches, two of the Q branches being very nearly coincident and unresolved. The rotational and vibrational constants of the upper states, $a'^3\Sigma^+$ and $e^3\Sigma^-$, of the two band systems have been determined. Some of these data had previously been obtained from perturbations in other band systems of CO. On the whole, the perturbation data agree satisfactorily with the more precise data obtained directly in the present study. A.

539.132 : 535.343

2288. ELECTRONIC SPECTRUM OF THE CYCLOHEPTATRIENYL (TROPYLIUM) ION. J.N.Murrell and H.C.Longuet-Higgins.
J. chem. Phys., Vol. 23, No. 12, 2347-8 (Dec., 1955).

The N $\rightarrow$ V spectrum of the tropylium ion, $C_7H_7^+$, is studied theoretically by the self-consistent molecular orbital theory. Two transitions are anticipated, an allowed transition at 6.36 eV and a forbidden transition at 4.33 eV. The absorption band at 4.51 eV observed by von Doering and Knox is assigned to the latter transition. A.

539.132

2289. EFFECT OF PRESSURE ON THE NUCLEAR QUADRUPOLE RESONANCE. D.Dautreppe and B.Dreyfus.
C.R. Acad. Sci. (Paris), Vol. 241, No. 13, 795-8 (Sept. 26, 1955). In French.

The pure quadrupole resonance of Cl^{35} in $p\text{-}C_6H_4Cl_2$ varies with pressure by + 33 c/s per $kg.cm^{-2}$. D.H.Whiffen

539.132

2290. ON THE BROADENING DUE TO IMPURITIES IN QUADRUPOLE RESONANCE. B.Dreyfus and D.Dautreppe.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1751-3 (Dec. 14, 1955). In French.

The effect of $p\text{-}C_6H_4Br_2$ impurity on the elastic constants of crystalline $p\text{-}C_6H_4Cl_2$ is shown to be of the correct order of magnitude to account for the observed shift and broadening of the Cl^{35} pure quadrupole resonance. D.H.Whiffen

539.132

2291. THEORY OF THE HYPERFINE STRUCTURE OF THE NO MOLECULE. II. ERRATA AND SOME ADDITIONAL DISCUSSION. C.C.Lin and M.Mizushima.
Phys. Rev., Vol. 100, No. 6, 1726-30 (Dec. 15, 1955).

A theoretical formula for the magnetic h.f.s. of diatomic molecules given in Abstr. 6783 (1954) is revised by including the Fermi term and correcting an error in the choice of phase. The new formula gives eQq = −1.7 Mc/s and eQq' = 22 Mc/s for the $^2\Pi$ state of the NO molecule. It was found that these constants together with the values a = 23.14 Mc/s, b = 14.056 Mc/s, for the parameters of the magnetic h.f.s. defined in the first paper give theoretical frequencies which explain not only 1/2 $\rightarrow$ 3/2 spectra but also the 3/2 $\rightarrow$ 5/2 transitions of the $^2\Pi_{1/2}$ state. A discussion on the theory of the magnetic resonance spectrum of the $^2\Pi_{3/2}$ state is also given. A.

539.132

2292. QUADRUPOLE SPECTRUM OF $BiCl_3$. H.G.Robinson.
Phys. Rev., Vol. 100, No. 6, 1731-4 (Dec. 15, 1955).

Pure nuclear quadrupole resonance absorptions were observed for Bi^{209}, Cl^{35} and Cl^{37} nuclei in polycrystalline $BiCl_3$ at both room and liquid air temperatures. Line assignments and the evaluation of the electric field gradient asymmetry parameter η allow the following coupling constants to be calculated: $|eQq|_{Bi}$ = 318.76 Mc/s for $\eta = 0.555$; $|eQq|_{Cl^{35}}$ = 30.196 Mc/s, 38.310 Mc/s. Two "forbidden" $|\Delta m'| = 2$ transitions were observed. A brief discussion of the data in connection with chemical bonding in the solid is given. A.

539.132

2293. ON THE COUPLING BETWEEN ELECTRONIC AND NUCLEAR MOTIONS IN MOLECULES. T.-Y.Wu and A.B.Bhatia.
J. chem. Phys., Vol. 24, No. 1, 48-52 (Jan., 1956).

The energy due to the coupling between the electronic and the nuclear motion in a molecular system has been calculated for the normal state of the hydrogen molecular ion H_2^+ and the

lowest $^1\Sigma$ and $^3\Sigma$ state of the hydrogen molecule H_2. It is found that this coupling is represented by a repulsive potential which is of the same order of magnitude as the van der Waals interactions at distances where the latter is important. Thus in any theoretical calculation of the interaction between light neutral atoms, it is necessary to include this coupling between the electronic and the nuclear motions. A.

539.132

2294. CORRELATION OF NUCLEAR QUADRUPOLE INTERACTION FREQUENCIES WITH POLAROGRAPHIC HALF-WAVE POTENTIALS. T.Iredale.
Nature (London), Vol. 177, 36-7 (Jan. 7, 1956).

539.132

2295. THE HYDROGEN BOND. N.D.Sokolov.
Uspekhi fiz. Nauk, Vol. 57, No. 2, 204-78 (1955). In Russian.

A survey article by the leading Soviet worker in the field. Among topics discussed are the following:- vibration spectra, the inadequacy of the simple electrostatic conception of the H-bond, quantum-mechanical treatment, calculation of the vibration frequency of an AH group in a complex with a hydrogen bond, the origin of the band in the vibration spectrum of an H-bond, electric and magnetic spectra, H-bond and proton transition processes. 139 refs. C.R.S.Manders

539.132

2296. π-ELECTRONIC STRUCTURE OF THE HCN MOLECULE. K.Iguchi.
J. chem. Phys., Vol. 23, No. 11, 1983-8 (Nov., 1955).

The HCN molecule is treated as a system of four π-electrons moving in a suitable potential field. Its lower excited states are calculated, using both the molecular orbital method with configuration interaction and the Heitler-London method including ionic-homopolar resonance. Slater atomic orbitals with effective charges $2\,\delta = 3.18$ for the C atom and 3.85 for the N atom are employed. The calculated energy levels with the $^1\Sigma^+$ ground state as zero are 3.53 eV ($^3\Sigma^+$), 5.60 eV ($^1\Sigma^-$), 7.71 eV ($^3\Delta$), etc. The effect of configuration interaction is remarkable, amounting to several electron volts, and ionic terms have almost the same weight as homopolar terms. A.

539.132

2297. CALCULATION OF THE CHARACTERISTIC CONSTANTS OF A MOLECULE STARTING FROM THE PARTIAL DERIVATIVES OF THE SECULAR EQUATION. I.Samuel.
C.R. Acad. Sci. (Paris), Vol. 241, No. 21, 1464-7 (Nov. 21, 1955). In French.

Expressions established earlier (Abstr. 8372/1955) are extended to the case of degenerate energy levels. As an example, self-polarizability and bond orders are calculated for benzene. J.Jacobs

539.132

2298. MOLECULAR CALCULATIONS. I. LCAO MO SELF-CONSISTENT FIELD TREATMENT OF THE GROUND STATE OF H_2O. F.O.Ellison and H.Shull.
J. chem. Phys., Vol. 23, No. 12, 2348-57 (Dec., 1955).

A theoretical study of the ground state of the water molecule utilizing the self-consistent field molecular orbital method in the linear-combination-of-atomic-orbitals approximation is reported. All 10 electrons have been explicitly included, and all integrals have been retained in the calculations. Results are listed for six different values of the bond angle from 90 to 180 degrees, but only for the experimentally observed OH distance. The effect of inner-shell outer-shell mixing is investigated and shown to have a significant effect upon the results. The electronic configuration is discussed both from the viewpoint of molecular and equivalent orbitals. The computed dipole moment is 1.51 D. The SCF ionization potentials agree well with the experimental values, their order of assignment being quite definitely established. The calculated total electronic energy is in error by about 0.75%. This energy changes by only 0.13% for a change in bond angle from 90^0 to 180^0, however, and consequently, the treatment leads to an incorrect value for the equilibrium bond angle. The effect of configuration interaction is considered, and some investigation is made concerning the first excited electronic state. A.

539.132

2299. MOLECULAR CALCULATIONS. II. METHODS OF APPROXIMATION OF MOLECULAR INTEGRALS. F.O.Ellison.
J. chem.Phys., Vol. 23, No. 12, 2358-65 (Dec., 1955).

A description is given of the integral approximations used in the LCAO MO self-consistent field treatment of H_2O reported in the preceding abstract. The estimation of electronic repulsion integrals by replacing one of the electron charge distributions by a point charge is considered in detail and found to be reliable in certain general cases. A modification of the Sklar approximation is developed which is applicable to integrals involving $1s_a\,\chi_b$, in which $\mu(1s_a)$ (effective Z) is small and $\mu(\chi_b)$ is large. A method is described for securing a better "corrected" Mulliken approximation of exchange integrals. The estimation of unsymmetrical nuclear attraction integrals is carried out by using uniformly charged spheres of finite size to represent AO distributions. This method is compared with the Mulliken and Löwdin approximations. A.

539.132 : 541.57

2300. ON THE THEORY OF BONDING OF BIVALENT DIATOMIC IONIC MOLECULES. BONDING OF ALKALINE EARTH METAL OXIDES. R.Gáspár and P.Csavinszky.
Acta phys. Hungar., Vol. 5, No. 1, 65-74 (1955). In German.

An examination of the applicability of the Jensen–Gombas method to bivalent ionic molecules with rare-gas structure. The computed values of 1.53 A and 4.50 eV for internuclear distance and dissociation energy are in good agreement with experimental values. For the electron density of the Mg^{2+} ion a Hartree–Fock distribution was assumed, while for the O^{2-} ion a semi-empirical Slater method was used to determine it. J.Jacobs

539.133 : 535.347

2301. INTERPRETATION OF INFRARED DICHROISM IN FIBROUS PROTEINS — THE 2 μ REGION. R.D.B.Fraser.
J. chem. Phys., Vol. 24, No. 1, 89-95 (Jan., 1956).

The assignment of the overtone and combination bands which appear in the infrared spectra of fibrous proteins between 4200 and 5500 cm^{-1} is discussed on the basis of the normal vibrations of an isolated - CO.NH - group. Equations relating the degree of molecular orientation in a protein fibre with transition moment direction and dichroic ratio are derived and the assignment of the transition moment direction associated with certain vibrations is considered. A.

539.133

2302. CALCULATION OF THE REACTION FIELD OF A DIPOLAR MOLECULE SURROUNDED BY IONS. J.E.Dubois and J.Barthel.
C.R. Acad. Sci. (Paris), Vol. 241, No. 21, 1460-2 (Nov. 21, 1955). In French.

Using an electric potential for the dipole–ion configuration as described previously (Abstr. 9812/1955) the field is determined according to Böttcher's method. The generalization to a molecule of polarizability α is easily made, and from this a definition for the total dipole moment of the molecule in a given medium is derived. J.Jacobs

539.133 : 537.533.74

2303. REFINED PROCEDURE FOR ANALYSIS OF ELECTRON DIFFRACTION DATA AND ITS APPLICATION TO CCl_4. L.S.Bartell, L.O.Brockway and R.H.Schwendeman.

J. chem. Phys., Vol. 23, No. 10, 1854-9 (Oct., 1955).

A refined procedure for obtaining the structure of free molecules from electron diffraction data is described which compensates for the interference arising from non-nuclear scattering. The procedure is applied to CCl_4 using somewhat more extensive rotating sector data than has hitherto been published for this molecule. Estimates are made for the first time in electron diffraction results of the effect of anharmonicity of vibration on the measurement of internuclear distance and of the effect of the failure of the Born approximation on the measurement of amplitudes of vibration. A method of estimating the reliability of the results is described. A.

539.133

2304. STRUCTURES OF CF_3Cl AND CH_3Cl. L.S.Bartell and L.O.Brockway.
J. chem. Phys., Vol. 23, No. 10, 1860-2 (Oct., 1955).

The molecular structures of CF_3Cl and CH_3Cl were determined by refined procedures of electron diffraction (preceding abstract). For CF_3Cl, the most probable C–F and C–Cl distances are 1.328 A and 1.751 A respectively and $\angle FCF = 108.6^\circ$. Results for CH_3Cl agree with the complete microwave determination. Vibrational amplitudes are in agreement with approximate calculations by Morino. A.

539.133 : 535.343

2305. STRUCTURE OF OZONE FROM THE MICROWAVE SPECTRUM BETWEEN 9000 AND 45 000 Mc. R.H.Hughes.
J. chem. Phys., Vol. 24, No. 1, 131-8 (Jan., 1956).

Although there have been numerous investigations of the structure of ozone during the last thirty years, no studies yielded universally accepted structures until the recent infrared and microwave work. The microwave spectrum gives structural information which can be interpreted unambiguously and which is more accurate than that obtained by other methods. In this study the rotational spectra have been obtained for six isotopic ozone molecules between 9000 and 45 000 Mc/s. The spectra of four of them have been identified to the extent necessary to determine the spectral constants, from which moments of inertia have been calculated. By taking the moments of inertia for a molecule two at a time, structural parameters of the molecules have been calculated. Because of the inertia defect, the three different sets of parameters for each molecule have small discrepancies. There is remarkable consistency between the parameters for the different molecules. Although the resultant bond length of 1.278 ± 0.002 A is consistent with the electron diffraction value of 1.26 ± 0.02 A, the apex angle value of $116^\circ 45' \pm 30'$ is inconsistent with the diffraction value of $127^\circ \pm 3^\circ$. The dipole moment of ozone has been determined to be 0.58 ± 0.05 Debye unit from the Stark effects of two low J-transitions. A.

539.133

2306. QUADRUPOLE COUPLING AND BOND CHARACTER IN THE VINYL HALIDES. J.H.Goldstein.
J. chem. Phys., Vol. 24, No. 1, 106-9 (Jan., 1956).

Quadrupole coupling data obtained from microwave spectroscopy are utilized in assessing double-bond character in planar molecules such as the vinyl halides. The approximations involved and the effect of structural uncertainties have been considered in detail. An uncertainty of 20% or less is estimated for the calculated values of δ, the number of halogen p_y electrons lost as a result of double bonding. Application of the method to vinyl chloride and vinyl iodide yields values of 0.06 and 0.03, respectively. A revised value of -72 Mc/s for $(eQq)_{bond}$ in vinyl chloride is reported. The present results are compared with conclusions based on other molecular properties. A.

539.133

2307. COMPARISON BETWEEN THE EFFECT OF THE EXCLUDED VOLUME ON THE MEAN SQUARE DIPOLE MOMENT AND ON THE MEAN SQUARE LENGTH OF MACROMOLECULAR CHAINS IN SOLUTION. J.Marchal, C.Wippler and H.Benoit.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1266-8 (Nov. 7, 1955). In French.

It is shown mathematically that the excluded volume has a much smaller effect on the mean square electric moment of a linear macromolecule than on the mean square of the distance between the ends of the chain, although it might have been expected that the effects would be comparable.

R.C.Murray

ATOMS. NUCLEUS. ISOTOPES 539.15

539.15

2308. ATOMIC AND NUCLEAR PHYSICS. R.S.Shankland.
New York: Macmillan (1955) xv + 529 pp.

Review in Proc. Phys. Soc. A, Vol. 68, Pt 12, 1206-7 (Dec., 1955). ".... discusses in its early chapters the atomic and kinetic theory, the history of the electron, and atomic, molecular and X-ray spectra..... There follows an interesting chapter on the solid state of matter..... The remainder of the book (rather less than half) is devoted to nuclear physics..... isotopes, natural radioactivity, induced transformations, nuclear energy sources, high energy processes and cosmic rays".

539.15

2309. ATOMIC PHYSICS (ATOMPHYSIK), VOLS. 1 AND 2. K.Bechert.
Berlin: Walter de Gruyter (1955) 120 and 109 pp. In German.

Review in Brit. J. appl. Phys., Vol. 7, No. 1, 41 (Jan., 1956). "...begins with the behaviour of gases and goes on to cathode rays, positive rays and mass spectroscopy. Particle counters and cloud chambers are briefly described, and the passage of fast particles through matter leads to Rutherford's experiments on α-particle scattering and the atomic nucleus. The last chapter deals with diffraction phenomena and dispersion."

539.152.1

2310. THE COLLECTIVE-PARTICLE MODEL AND ITS APPLICATIONS TO HEAVY NUCLEI. M.Trocheris.
Cahiers de Phys., No. 61, 1-11 (Sept., 1955). In French.

The collective-particle model is presented as a modification of the shell model. Deformations of the core are treated as slow, and the motions of the nucleons as fast, in the sense of the Born–Oppenheimer approximation. Applications are made to the calculation of quadrupole moments and rotational levels. P.T.Matthews

539.152.1

2311. THE EXCITED STATES OF EVEN-EVEN NUCLEI AND THE BOHR-MOTTELSON MODEL. M.Jean and L.Wilets.
C.R. Acad. Sci. (Paris), Vol. 241, No. 17, 1108-10 (Oct. 24, 1955). In French.

In the model the effect of the individual nucleons appears in the surface Hamiltonian only through an effective potential W. The extreme case is considered here when W is independent of the symmetry properties of the deformation. The excited levels are calculated for both large and small deformations. L.Pincherle

539.152.1

2312. 2 – STATE AT 8.87 MeV IN O^{16}. D.H.Wilkinson, B.J.Toppel and D.E.Alburger.
Phys. Rev., Vol. 101, No. 2, 673-84 (Jan. 15, 1956).

The bombardment of F^{19} by protons of energy greater than 3 MeV, and the beta-decay of N^{16} are shown to give rise to gamma-rays of energies 2.75 ± 0.02 MeV, 1.90 ± 0.03 MeV, and 1.72 ± 0.03 MeV. The first of these gamma-rays is in coincidence with gamma-rays of 6.1 MeV while the latter two

are in coincidence with gamma-rays of greater than 6.3 MeV. The relative intensities are in the ratio of 27 : 1 : 3, respectively. These observations imply a state at 8.87 ± 0.02 MeV in O^{16} formed in the reactions $F^{19}(p,\alpha)O^{16}$ and $N^{16}(\beta^-)O^{16}$; this state is very probably 2-. The relevance of this observation for the alpha-particle model of O^{16} is discussed. A.

539.152.1

2313. FIRST 0^+ LEVEL IN C^{12} AND O^{16}. P.J.Redmond.
Phys. Rev., Vol. 101, No. 2, 751-2 (Jan. 15, 1956).

A model is proposed to explain the electric monopole ($0^+ \rightarrow 0^+$) matrix element for the transition between the ground- and 7.68 MeV state in C^{12} and between the ground- and 6.06 MeV state in O^{16}. In this model the first excited 0^+ state in C^{12} and O^{16} is described by an independent-particle wave-function which is identical to the ground-state wave-function except for the fact that one of the 1s nucleons in the "alpha-particle core" is replaced by a 2s nucleon. The calculation is performed using harmonic-oscillator wave-functions and the results are found to be in excellent agreement with the present experimental information. A.

539.152.1 : 537.533.74

2314. HIGH-ENERGY ELECTRON SCATTERING AND THE CHARGE DISTRIBUTIONS OF SELECTED NUCLEI. B.Hahn, D.G.Ravenhall and R.Hofstadter.
Phys. Rev., Vol. 101, No. 3, 1131-42 (Feb. 1, 1956).

Experimental results are presented of electron scattering by Ca, V, Co, In, Sb, Hf, Ta, W, Au, Bi, Th and U, at 183 MeV and (for some of the elements) at 153 MeV. For those nuclei for which asphericity and inelastic scattering are absent or unimportant, i.e., Ca, V, Co, In, Sb, Au and Bi, a partial wave analysis of the Dirac equation has been performed in which the nuclei are represented by static, spherically symmetric charge distributions. Smoothed uniform charge distributions have been assumed; these are characterized by a constant charge density in the central region of the nucleus, with a smoothed-out surface. Essentially two parameters can be determined, related to the radius and to the surface thickness. An examination of the Au experiments shows that the functional forms of the surface are not important, and that the charge density in the central regions is probably fairly flat, although it cannot be determined very accurately. An analysis of the experiments on the nuclei Ca, V, Co, In, Sb, Au and Bi, assuming for convenience the Fermi smoothed uniform shape (1), then leads to the following results: the radial parameter c (the distance to the midpoint of the surface) scales as $A^{1/3}$ for the nuclei examined and is $(1.07 \pm 0.02)A^{1/3} \times 10^{-13}$ cm; the surface thickness t (the $0.9\rho_0$ to $0.1\rho_0$ distance) is constant for all of these nuclei, to within the estimated error, and is $(2.4 \pm 0.3) \times 10^{-13}$ cm. A.

539.152.2

2315. PARAMAGNETIC NUCLEAR RESONANCE. DIPOLE AND QUADRUPOLE MOMENTS. (La résonance paramagnetique nucléaire. Moments dipolaires et quadripolaires.)
Edited by P.Grivet.
Paris: Centre National de la Recherche Scientifique (1955) 298 pp. In French.

Nuclear resonance is treated in 9 monographic chapters. 1. Introduction, by P.Grivet. 2. Macroscopic theories, by R.Gabillard. 3. Quantum theory, by Y.Ayant. 4. Experimental methods, by R. Gabillard. 5. Practical examples of apparatus, by R. Gabillard and M. Soutif. 6. Magnetic field production, by G.J.Béné, P.M.Denis and R.C.Extermann. 7. Gyromagnetic ratios, a table of values, by Y.Ayant and G.Béné. 8. Quadrupole resonance, by Y.Ayant and M.Buyle-Bodin. 9. Gyromagnetic ratios and nuclear magnetic moments, a brief account of nuclear theory, by G.J.Béné, P.M.Denis and R.C.Extermann. D.H.Whiffen

539.152.2

2316. THE AMPLITUDES OF THE PRIMARY ECHOES WITH THE HAHN-SPIN-ECHO METHOD. H.Pfeifer.
Ann. Phys. (Leipzig), Vol. 17, No. 1, 23-7 (1955). In German.

The Hahn echo signal amplitude in nuclear magnetic resonance is derived theoretically as a function of departure from the resonance frequency, the r.f. field amplitude, H_1, the pulse length, t_w, and the interval between the pulses. For $\gamma H_1 t_w = 2\pi/3 + 2k\pi$ or $4\pi/3 + 2k\pi$ where k = 1, 2, 3, ... there is more than one echo amplitude maximum as the degree of off resonance is varied; this is confirmed by experiment. The influence of field inhomogeneity is also discussed. D.H.Whiffen

539.152.2

2317. THE GYROMAGNETIC RATIO OF THE PROTON.
F.Kirchner and W.Wilhelmy.
Z. Naturforsch., Vol. 10a, No. 8, 657-8 (Aug., 1955). In German.

Using the Bloch—Purcell resonance method and a magnetic field of strength 100 oersted, produced by means of a solenoid, the value of γ_p was determined as $(2.675\,69 \pm 0.000\,17) \times 10^4$ sec^{-1}. oersted^{-1}; cf. $(2.675\,30 \pm 0.000\,06) \times 10^4$ obtained by Thomas et al. (Abstr. 7441/1950). E.P.Wohlfarth

539.152.2

2318. NUCLEAR ORIENTATION OF CERIUM 141.
C.F.M.Cacho, M.A.Grace, C.E.Johnson, A.C.Knipper, R.G.Scurlock and R.T.Taylor.
Phil. Mag., Vol. 46, 1287-94 (Dec., 1955).

Ce^{141} has been aligned by the method of magnetic h.f.s. (alignment) in a crystal of cerium ethyl sulphate. From measurements of the angular distribution and the plane of polarization of the gamma-radiation it is concluded that the gamma-ray transition is principally M1 with a small admixture of E2 ($\delta = +0.08 \pm 0.02$). Values of 0.75 ± 0.20 and 0.66 ± 0.16 nuclear magnetons are found for the nuclear moment of Ce^{141}, depending on whether the β-transition involves a spin change of 1 or 0. A.

539.152.2

2319. NUCLEAR MOMENTS OF Mo^{95}, Mo^{97}, Zr^{91}, I^{127}, Sb^{121} AND Sb^{123}. K.Murakawa.
Phys. Rev., Vol. 100, No. 5, 1369-72 (Dec. 1, 1955).

The hyperfine structure (h.f.s.) of the spectrum of Mo I was studied, and it was found that both Mo^{95} and Mo^{97} have nuclear spins equal to 7/2. Substituting this in the g-values of Mo^{95} and Mo^{97} given in the literature, the magnetic moments $\mu(Mo^{95}) = -1.2736$ nm and $\mu(Mo^{97}) = -1.3006$ nm (without diamagnetic correction) are obtained. H.f.s. investigation of the spectrum of Zr I yielded the result that $\mu(Zr^{91}) = -1.9 \pm 0.2$ nm. The quadrupole moment of I^{127} as derived from the h.f.s. of the visible spectrum and as derived from the atomic beam resonance technique published in the literature is discussed, and it is concluded that $Q(I^{127}) = (-0.69 \pm 0.03) \times 10^{-24}$ cm^2 including the polarization correction due to Sternheimer. Data concerning the h.f.s. of the spectrum of Sb II are discussed, and it is shown that they support the values $Q(Sb^{121}) = (-0.53 \pm 0.10) \times 10^{-24}$ cm^2 and $Q(Sb^{123}) = (-0.68 \pm 0.10) \times 10^{-24}$ cm^2 (including the polarization correction) that were deduced previously. A.

539.152.2

2320. SATURATION IN NUCLEAR MAGNETIC RESONANCE
F.Lurçat.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1932-4 (Dec. 19, 1955). In French.

A theoretical treatment of the saturation of nuclear magnetic resonance at high powers with several energy levels possessing different relaxation times, but with transitions between neighbouring levels simultaneously excited; T_1 has to be replaced by an average relaxation time. D.H.Whiffen

539.152.2 : 538.222

2321. THE NUCLEAR MAGNETIC MOMENT OF HOLMIUM

165. J.M.Baker and B.Bleaney.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1090-1 (Nov., 1955).
Interpretation of the electron resonance spectrum of Ho^{165} in yttrium ethyl sulphate indicates $I = 7/2$, $\mu_n = (+) 3.29 \pm 0.17$ n.m. and $Q \cong + 2 \times 10^{-24}$ cm^2. D.H.Whiffen

539.153

2322. RELATIVISTIC RADIATIVE TRANSITIONS.
W.B.Payne and J.S.Levinger.
Phys. Rev., Vol. 101, No. 3, 1020-6 (Feb. 1, 1956).
The oscillator strength for electric dipole transitions was calculated with retardation between the 1s state and higher discrete states for a single Dirac electron in a Coulomb field. Numerical values for atomic number 82 show that the retarded relativistic oscillator strength for each shell is about 0.8 of the nonrelativistic value. Numerical values are given for the relative intensity of the different K X-ray lines for lead, neglecting screening: The $K\alpha_1/K\alpha_2$ doublet intensity ratio is 1.93 as compared to the NR value of 2.0. The authors introduce an average "oscillator density" for transitions for discrete states, and extrapolate to the series limit to find the photoelectric cross-section at threshold. Their numerical value for lead of 740 barns is 23% larger than the value given by Hulme et al. They also calculate the summed oscillator strength, using a cutoff at an arbitrary high energy to give convergence. The numerical results for lead are insensitive to the numerical value of the cutoff: using 10 MeV, they find a summed oscillator strength of 0.85, with an increase of 0.01 for each factor of two increase in the cutoff energy. Their value of the summed oscillator strength is less than that calculated nonrelativistically by Thomas, Reiche and Kuhn; or relativistically by Gell-Mann, Goldberger and Thirring. A.

539.153

2323. NOTE ON SUCCESSION TRANSITIONS IN MESIC ATOMS. M.I.Podgoretskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 374-5 (1955). In Russian.
Correlations between successive γ-rays depend on the total angular momenta of the levels; since the orbital momenta of the levels are known, this affords a way of finding experimentally the spin of μ- or heavy mesons. For example, in the transition $3p \rightarrow 2s \rightarrow 2p$ the angular distribution is isotropic for spin $\frac{1}{2}$, anisotropic for spin $\frac{3}{2}$. G.E.Brown

539.153 : 539.18

2324. CALCULATION OF TERM VALUES AND FINE-STRUCTURE SPLITTINGS IN MESONIC ATOMS. S.Flügge and W.Zickendraht.
Z. Phys., Vol. 143, No. 1, 1-16 (1955). In German.
The calculation is carried out by minimizing the energy, starting from trial functions (Ritz variational method). The nuclear potential is taken to be that from a uniform nuclear charge distribution, but it is shown how to obtain answers for slightly different distributions. G.E.Brown

539.153.4

2325. SELF-CONSISTENT FIELD OF FOCK IN THE THREE-CONFIGURATIONAL APPROXIMATION FOR BERYLLIUM. V.V.Kibartas, V.I.Kavetskis and A.P.Yutsis.
Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 623-8 (1955). In Russian.
The three configurations $1s^2\,2s^2$, $1s^2\,2p^2$ and $2s^2\,2p^2$ were employed. Correction to the one-configurational energy was 0.064 atomic units, leaving a discrepancy with experiment of only 0.024 units. G.E.Brown

539.153.4

2326. EXCITATION PROBABILITIES OF THE TWO-ELECTRON ATOM. P.Kessler.
C.R. Acad. Sci. (Paris), Vol. 241, No. 16, 1030-1 (Oct. 17, 1955). In French.
The effect of the electrostatic repulsion of the two electrons on the probability of transitions such as $1s^2 - 1snp$ is calculated by ordinary perturbation theory and found to be important, particularly for large n when it appreciably increases the transition probabilities calculated neglecting the electrostatic repulsion. On the other hand the probability of the transition $1s^2 - 1s2p$ is reduced. L.Pincherle

539.153.4

2327. THE SELF-CONSISTENT FIELD FOR Zr^{4+}.
S.L.Altmann.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 987-93 (Nov., 1955).
A fairly general programme for the computation of atomic self-consistent fields without exchange has been prepared for the Manchester University electronic computer. Results obtained for the Zr^{4+} ion are given. A.

539.153.4

2328. "CONTACT INTERACTION" IN THE RELATIVISTIC ENERGY OF TWO-ELECTRON ATOMS. T.-Y.Wu and G.E.Tauber.
Phys. Rev., Vol. 100, No. 6, 1767-70 (Dec. 15, 1955).
It is shown that the "contact interaction" recently pointed out by Sessler, Sucher and Foley for the relativistic two-electron atoms can be very simply and unambiguously obtained from the field-theoretical form of the theory of Breit and Møller, whereas the original "reduction" procedure (reducing the equation for the 16-component wave function to one for the four big components by successive approximation) does not lead to this contact term. The effect of the singular behaviour of relativistic wave function at the origin gives rise to a correction of order α^4 in the energy. A.

539.153.4 : 537.56

2329. THE CALCULATION OF AUTO-IONIZATION PROBABILITIES. III. AUTO-DETACHMENT FROM THE NEGATIVE HYDROGEN ION. B.H.Bransden and A.Dalgarno.
Proc. Phys. Soc. A, Vol. 69, Pt 1, 65-9 (Jan., 1956).
For Pt II see Abstr. 701(1954). The probability of auto-detachment from $H^-(2s2p)^3P$ is calculated using both a time-dependent perturbation and a time-independent variational method. The values obtained are in essential agreement and are of the order 4×10^{12} sec^{-1}, about 100 times smaller than for the similar neutral case of $He(2s2p)^3P$. A.

539.154 : 53.081

2330. ANALYSIS OF VARIANCE OF THE 1952 DATA ON THE ATOMIC CONSTANTS AND A NEW ADJUSTMENT, 1955. E.R.Cohen, J.W.M.DuMond, T.W.Layton and J.S.Rollett.
Rev. mod. Phys., Vol. 27, No. 4(I), 363-80 (Oct., 1955).
The 1952 data used by DuMond and Cohen in an evaluation of the atomic constants (Abstr. 1583/1954) are analysed for the presence of systematic errors by a variance analysis performed by an electronic digital computer. For simplicity the velocity of light is treated as a fixed constant of known value and there remain then eleven linear equations in four unknowns subject to least-squares adjustment. Least-squares adjustments of 219 over-determined subsets of these equations have been made and χ^2 has been evaluated for each such subset. An analysis of these data indicates that small systematic errors are most likely to exist in the following input data: (1) The determination of the Faraday by the silver voltameter. (2) The determination of the cyclotron resonance frequency of the proton by the inverse cyclotron method of Bloch and Jeffreys. (3) Certain of the higher voltage determinations of h/e by the continuous X-ray quantum limit. In descending order of magnitude of discrepancy from the remaining data on the constants are the determinations of (a) Felt, Harris, and DuMond made at 24 500 volts, (b) Bearden and Schwarz at 19 600 volts, (c) Bearden and Schwarz and also Bearden, Johnson and Watts in the region between about 10 kV and about 6 kV. An analysis of the various observations taken by these observers at different voltages reveals a possible systematic

trend when discrepancy is plotted against either voltage or window width in volts. Conjectures to account for the effect are discussed. The modifications called for by this analysis yield a new 1955 adjustment in which χ^2 is smaller than it was for the November, 1952 adjustment. The new $\chi^2 = 3.25$ is satisfactorily close to its expected value, 3. Thanks to the fact that the error measures adopted in the November, 1952 adjustment for the output values were conservatively based on the criterion of external consistency, the changes in the values occasioned as a result of the present analysis are all well within those estimated limits. A welcome effect of this new adjustment is that the adjusted output value of λ_g/λ_s, the conversion factor from Siegbahn's x-units to milli-angstroms, now lies much closer to the input value. A new table of constants and conversion factors is presented. A.

539.155.2 : 537.36

2331. CONCENTRATING ISOTOPES BY ELECTROMIGRATION ON ASBESTOS IMPREGNATED WITH MOLTEN SALTS. M.Chemla and A.Bonnin.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1288-91 (Nov. 7, 1955). In French.

The investigation of the electromigration of Na^{22} and Na^{24} has been made possible by the use of asbestos paper impregnated with molten KNO_3 and $NaNO_3$. After 4 hours (potential applied 700 V, current 100 mA), the distance covered was 35 cm (equivalent to about 9 cm/hr in a field of 14 V/cm), and the Na^{22}/Na^{24} ratio varied from 0.6 to 1.8 for the two opposite extreme points of the radioactive spot, respectively.
F.Lachman

539.155.2 : 539.152.2

2332. THE MEASUREMENT, BY NUCLEAR RESONANCE, OF LIGHT WATER CONCENTRATION IN MIXTURES OF LIGHT AND HEAVY WATER. A.M.J.Mitchell and G.Phillips.
Brit. J. appl. Phys., Vol. 7, No. 2, 67-72 (Feb., 1956).

Nuclear resonance absorption is induced in protons contained in mixtures of light and heavy water. The magnitude of the power absorption is used as a measure of the concentration of light water present and samples of known concentration are used to standardize the absorption. Two techniques for inducing the absorption are described, one appropriate for H_2O concentrations in the range 7-100% and the other for low concentrations. In both cases the signal output from the equipment rises almost linearly with H_2O concentration. Using the first method, a signal-to-noise voltage ratio of twenty is obtained with a 7% concentration. A similar ratio is obtained from samples with 0.2% H_2O by using the second technique. The effect of flowing low-concentration samples through the apparatus has been studied. The signal output falls with flow rate and at 40 ml./sec is half that obtained at zero flow. Suggestions are made for improving the stability of the equipment and for reaching a quantitative theoretical understanding of the absorption signal shapes observed. A.

539.155.2 : 539.16.08

2333. IMPROVED METHANE PROPORTIONAL COUNTING METHOD FOR TRITIUM ASSAY. C.V.Robinson.
Nucleonics, Vol. 13, No. 11, 90-1 (Nov., 1955).

A tritium-labelled aqueous sample is treated with methyl Grignard reagent to generate labelled methane. The latter is purified and transferred into a proportional counter, a metal system being employed. The specific activity of the methane which is determined in the counter is 0.227 ± 0.002 of the original water activity and 11% of the disintegrations in the sample are counted. The method has a coefficient of variation of 0.7% and the lowest detectable tritium concentration in the sample is 6×10^{-10} curies/cm^3. L.R.Shepherd

539.155.2 : 541.13

2334 THE ISOTOPE EFFECT OF A DIRECT ELECTRIC CURRENT THROUGH LIQUID AND SOLID METALS. E.Haeffner, T.Sjöborg and S.Lindhe.
Z. Naturforsch., Vol. 11a, No. 1, 71-5 (1956).

The separation effect is demonstrated by passing a current through mercury, which is enclosed in a capillary tube. The second part of the paper deals with an attempt at establishing an isotope effect when a direct current is passed through an uranium wire. A

539.156

2335. THE INFLUENCE OF RETARDATION ON THE LONDON–VAN DER WAALS FORCES. J.W.Leech.
Phil. Mag., Vol. 46, 1328-36 (Dec., 1955).

A calculation is made of the effect of including the retarde potential term of quantum electrodynamics when evaluating the van der Waals interaction between two atoms. In disagreement with the conclusions of Casimir and Polder the interactic energy at large distances is found to vary as R^{-3}. A.

539.156

2336. THE REPRESENTATION OF LONG RANGE FORCES BY SERIES EXPANSIONS. I. THE DIVERGENCE OF THE SERIES. II. THE COMPLETE PERTURBATION CALCULATION OF LONG RANGE FORCES. A.Dalgarno and J.T.Lewis
Proc. Phys. Soc. A, Vol. 69, Pt 1, 57-59, 59-64 (Jan., 1956)

In I, the divergence which arises when long range interatomic forces are represented by power series expansions in the reciprocal of the nuclear separation is shown to be a fundamental property of such series and is not due to the use of an expansion of the perturbing potential in regions of space where it is not valid. It is shown that the series representation is a very convenient one despite its divergence. In II, the usual second order perturbation treatment is extended to include higher orders leading to the presence of odd powers in the series and the convergence of the perturbation series is discussed quantitatively. Results are given for H_2^+ and H_2. Finally the limitations of the series representation are briefly considered. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

2337. THE EFFECT OF LIGHT ON CERIC-CEROUS DOSIMETRY. S.W.Nicksic and J.R.Wright.
Nucleonics, Vol. 13, No. 11, 104-6 (Nov., 1955).

It has been observed that appreciable reduction of ceric-ions takes place in solutions exposed to visible or ultraviolet light. This must be taken into account when using ceric-cerous dosimeters for radiation monitoring. L.R.Shepherd

539.163

2338. DISINTEGRATION OF Te^{129}. W.E.Graves and A.C.G.Mitchell
Phys. Rev., Vol. 101, No. 2, 701-5 (Jan. 15, 1956).

The disintegration of Te^{129} has been investigated with the help of a magnetic lens spectrometer, permanent field spectrometer with photographic recording, and scintillation counters. The half-lives of the isomeric states in the parent were found to be 41 days and 74 minutes, respectively. The 74 minute state decays to I^{129} with the emission of beta-ray groups whose end-point energies and relative abundances are 1.453 MeV (71%), 0.989 MeV (15%), 0.69 MeV (4%) and 0.29 MeV (10%). Gamma-rays of 0.027, 0.21, 0.475, 0.72 and 1.12 MeV were found. The 41 day state decays, for the most part, to the 74 minute state of Te^{129} with the emission of a highly internally converted gamma-ray of energy 106.3 ± 0.1 keV for which the K/L ratio is unity. A beta-ray transition, of low intensity, from the 41 day state of Te^{129} to the ground state of the product is postulated. Gamma-gamma and beta-gamma coincidence experiments using scintillation spectrometers served to indicate the probable level scheme of I^{129}. A discussion of the disintegration scheme is given suggesting probable spins and parities of the levels. A.

539.163

2339. THE DECAY OF ^{40}K. A.McNair, R.N.Glover and H.W.Wilson.
Phil. Mag. (Ser. 8), Vol. 1, 199-211 (Feb., 1956).

The decay of K^{40} has been reinvestigated and values of the branching ratio, defined as the ratio of gamma or electron capture to beta transitions, have been determined by two methods, giving the values 0.124 ± 0.002 and 0.121 ± 0.004 respectively. The absolute beta and gamma decay rates and the half-life have been measured, the value of the latter being $1.28 \pm 0.02 \times 10^9$ years. A fresh determination of the gamma energy is described, and evidence as to the mode of decay is discussed. Finally, the results are given of experiments on the reflection of electrons by solid source-supports. A.

539.163.1

2340. THE SHORT-LIVED MOLYBDENUM AND TECHNETIUM ISOBARS OF MASS-NUMBER 105. J.Flegenheimer, G.B.Baró and A.Medina.
Z. Naturforsch., Vol. 10a, No. 9-10, 798-9 (1955). In German.

Decay measurements using chemically separated U fission products gave the following half-value periods: Tc^{105}, 10 ± 1 min; Mo^{105}, less than 2 min; $Mo^{107,109}$ and $Tc^{107,108}$, less than 1 min. A.O.Stanesby

539.163.1

2341. ALPHA HALF-LIFE OF Pu^{244}. H.Diamond and R.F.Barnes.
Phys. Rev., Vol. 101, No. 3, 1064-6 (Feb. 1, 1956).

The half-life of Pu^{244} was found to be $(7.6 \pm 2) \times 10^7$ years by measuring the activity of its Np^{240} decay product. The possibility of detecting Pu^{244} in nature with current techniques and the role of Pu^{244} and its daughters as an early source of terrestrial heat are discussed. A.

539.163.1 : 521.04

2342. EFFECT OF PRESSURE ON RADIOACTIVE PERIODS. E.Schatzman.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 853-4 (Oct. 3, 1955). In French.

It is shown that, at very high densities, such as may exist in stellar atmospheres, the pressure effect will tend to increase the radioactive period: this may have important consequences in the formation of the radioactive elements, more especially Po. D.R.Barber

539.163.2

2343. ON THE β-DECAY OF NATURAL ACTINIUM; DECAY SCHEME AND β-SPECTRUM. W.Beckmann.
Z. Phys., Vol. 142, No. 5, 585-601 (1955). In German.

Investigated with a proportional counter, the decay is to the ground state of RdAc and the β-spectrum has an allowed shape from 7 keV to the end point at 45.5 ± 1 keV (log ft = 6.9). No evidence was found for the distortion of the spectrum by the electron cloud. J.Hughes

539.163.2

2344. FORMATION AND PROPERTIES OF NEUTRON-DEFICIENT ISOTOPES OF RHODIUM AND PALLADIUM. A.H.W.Aten, Jr and T.de Vries-Hamerling.
Physica, Vol. 21, No. 7, 597-8 (July, 1955).

The nuclide Rh^{97} (half-life 32 minutes) has been definitely identified, and Rh^{96} (9 minutes) and Pd^{96} (17 minutes) probably identified. The 9 minute rhodium has a maximum β-energy of 3.3 ± 0.4 MeV, and a 650 keV γ-ray is also emitted. Possible observations of Rh^{99} and Pd^{99} are reported. J.M.Cassels

539.163.2

2345. A NEW HEAVY IRON ISOTOPE (Fe-61). E.Ricci, J.Pahissa Campá and N.Nussis.
Z. Naturforsch., Vol. 10a, No. 8, 654 (Aug., 1955). In German.

A new heavy Fe isotope (Fe^{61}) with a ½-life of 5.5 min was obtained by irradiation of Ni with fast (up to 20 MeV) neutrons, and with deuterons of 28-30 MeV; and of Cu with fast neutrons. It disintegrates by negative electron emission to Co^{61}, and also emits γ-rays. A.O.Stanesby

539.163.2

2346. RADIOCHEMICAL STUDY OF Tl^{195}, Tl^{197}, AND Tl^{198m}. J.D.Knight and E.W.Baker.
Phys. Rev., Vol. 100, No. 5, 1334-8 (Dec. 1, 1955).

A new neutron-deficient nuclide, Tl^{195}, was produced by 20 MeV deuteron bombardment of Hg^{196}, and its identity and its half-life (1.2 ± 0.1 hours) established by timed chemical separations of the Hg^{195} daughter. The assignment and half-life (2.8 ± 0.2 hours) of Tl^{197} was confirmed by timed chemical separations of its Hg^{197} daughter. The radiations of Tl^{197} and Tl^{198m} were examined with a gamma scintillation spectrograph and a 180° beta-ray spectrograph. The presence of a number of new gamma-rays associated with Tl^{198m} reveals an electron capture branch in the decay of this isomer; the data indicate a ratio of electron captures to isomeric transitions between 1 and 2. A.

539.163.2

2347. THE DECAY OF Re^{186} AND Re^{188}. M.W.Johns, C.C.McMullen, I.R.Williams and S.V.Nablo.
Canad. J. Phys., Vol. 34, No. 1, 69-82 (Jan., 1956).

The energies and intensities of 13 gamma-rays in Re^{188} have been measured by studying their external conversion spectra with a high resolution beta-ray spectrometer. An analysis of the beta-ray spectrum reveals groups with end points 2116 keV (79%) and 1961 keV (20%), and several low energy groups whose total intensity is of the order of 1%. The observed data can be consistently accounted for in terms of a decay scheme involving the following levels of Os^{188}: 0.0, 155.0, 633, 1086, 1306, 1461, 1765, 1941 and 1958 keV. This scheme is firmly supported by coincidence measurements. The spins of the first three levels listed are 0+, 2+ and 2+ and that of the 1461 keV level is probably 0+. The decay of Re^{186} is accompanied by gamma-rays of the following energies and quantum intensities: 122.9 keV (0.6%), 137.2 keV (10%), 630.8 keV (0.024%) and 768.2 keV (0.024%). These values are in good agreement with those quoted in the literature, except for the intensities of the last two radiations. A.

539.163.2

2348. THE ROLE OF THE 1.30 MeV GAMMA-RAY IN THE DECAY OF In^{114}. M.W.Johns, I.R.Williams and D.E.Brodie.
Canad. J. Phys., Vol. 34, No. 1, 147-9 (Jan., 1956).

The coincidence measurements reported show that the 1.3 MeV γ-ray is not in cascade with other γ-rays, but is in coincidence with a β-spectrum of end-point 710 ± 50 keV. (log ft = 5.5). The 1.3 MeV γ-ray is attributed to decay of a 1.3 MeV, 2^+ state in Sn^{114}. J.J.Wilkins

539.163.2

2349. NUCLEAR LEVELS IN Sr^{88} FROM THE DISINTEGRATION OF Rb^{88} AND Y^{88}. N.H.Lazar, E.Eichler and G.D.O'Kelley.
Phys. Rev., Vol. 101, No. 2, 727-32 (Jan. 15, 1956).

The nuclear level structure of Sr^{88} has been studied through the gamma radiation following the decays of 17.8 min Rb^{88} and 104 day Y^{88}. Gamma-rays from Rb^{88} with energies of 0.909 ± 0.004, 1.39, 1.850 ± 0.008, 2.11, 2.68, 3.01, 3.24, 3.52, 3.68 and 4.87 MeV have been resolved and fitted into a level scheme with the assistance of coincidence spectroscopy using cylindrical 3 inch x 3 inch NaI(Tl) crystals. The intensity of the ground state beta-ray transition from Rb^{88} was determined by comparing the total beta-ray activity to the intensity of the 1.85 MeV gamma-ray. It was found that $75.9 \pm 5.0\%$ of the decays are directly to the ground state. From the

gamma-ray intensities, the comparative half-lives of all the beta groups could be determined and, thus, parity assignments were made to all the levels. The relative intensities of gamma-rays leaving the same level is discussed in relation to single-particle transition probabilities. A.

539.163.2

2350. RADIATIONS FROM P^{30}, Cl^{34} AND K^{38}. D.Green and J.R.Richardson.
Phys. Rev., Vol. 101, No. 2, 776-8 (Jan. 15, 1956).

Results are reported on the measurement of the radiations from the 2.55 min activity in P^{30}, the 32.40 ± 0.04 min activity in Cl^{34} and the 7.7 min activity in K^{38} by means of a large double-lens spectrometer and a NaI scintillation spectrometer. P^{30} has a simple positron spectrum with end point at 3.24 ± 0.04 MeV and no gamma rays or conversion electrons. Cl^{34} has a complex positron spectrum with end points at 4.50 ± 0.03 MeV 2.48 ± 0.07 MeV and 1.33 ± 0.10 MeV. K^{38} has a simple positron spectrum with end point at 2.68 ± 0.04 MeV and no conversion electrons. These results indicate an ft value for the ground (T = 1) state of Cl^{34} of 3160 ± 120 sec, and indicate that the ground states of P^{30} and K^{38} are probably the T = 0 states. A.

539.163.2

2351. DECAY CHAIN Ca^{49}-Sc^{49}-Ti^{49}. G.D.O'Kelley, N.H.Lazar and E.Eichler.
Phys. Rev., Vol. 101, No. 3, 1059-63 (Feb. 1, 1956).

The decays of Ca^{49} and its daughter have been studied by beta- and gamma-ray scintillation spectroscopy. Ca^{49} was observed to decay with a half-life of 8.75 ± 0.20 min, exciting gamma-ray transitions in Sc^{49} of 3.10 ± 0.03, 4.05 ± 0.05 and 4.68 ± 0.05 MeV energy and relative intensities of 1.0, 0.11 ± 0.02 and 0.0038 ± 0.0010. Two beta-ray groups were resolved from the Ca^{49} spectrum of energy 1.95 ± 0.05 and 0.89 ± 0.15 MeV. In agreement with previous work, Sc^{49} was found to be a pure beta emitter. The beta-ray energy of Sc^{49} was measured as 2.05 ± 0.05 MeV, and the half-life was found to be 57.2 ± 0.7 min. Spin assignments are proposed on the basis of the single-particle model. A.

539.164

2352. ALPHA-DECAY PROPERTIES OF Am^{239}. F.Asaro, F.S.Stephens, Jr, W.M.Gibson, R.A.Glass and I.Perlman.
Phys. Rev., Vol. 100, No. 5, 1541-2 (Dec. 1, 1955).

The alpha-gamma coincidence spectrum consisted of peaks at 48.3 ± 1.5 and 17 keV. The intensity of the 48 keV peak was 0.5 ± 0.1 per alpha disintegration, almost certainly establishing it as E1. Since the conversion coefficient can be estimated to be of order unity, it follows that almost every alpha disintegration of Am^{239} goes through the 48 keV state, as is the case for the analogous transitions of Am^{241} and Am^{243}. J.Hughes

539.164 : 539.165

2353. BETA–ALPHA ANGULAR CORRELATION OF Li^8. M.Morita and M.Yamada.
Progr. theor. Phys., Vol. 13, No. 1, 114-15 (Jan.); Errata, ibid., No. 2, 225 (Feb., 1955).

It is suggested that even though the β-decay is allowed some correlation may exist in the successive decays because due to the very high maximum energy the contributions from the p- and d- waves, normally neglected in the usual treatment of allowed transitions, cannot be ignored. A table is given of the numerical coefficient in the angular correlation function calculated under certain assumptions as to the spin values of the states involved. J.Hughes

539.164 : 539.166

2354. ALPHA-GAMMA ANGULAR CORRELATION IN Bi^{212} (ThC). J.W.Horton.
Phys. Rev., Vol. 101, No. 2, 717-25 (Jan. 15, 1956).

The alpha-gamma angular correlation function, $W(\theta)$, of the cascade

$$Bi^{212}(ThC) \xrightarrow{\alpha\ (6.04\ MeV)} Tl^{208*} \xrightarrow{\gamma\ (40\ keV)} Tl^{208}(ThC'')$$

was determined by experiment to be consistent with a predicted law of the form $W(\theta) = 1 + A\cos^2\theta$. The ratio $W(90^\circ)/W(180^\circ)$ was measured to be 1.2993, ± 0.0095 due to statistics, and ± 0.010 due to experimental corrections. Comparison of this result with predictions of alpha-gamma angular correlation theory shows that Bi^{212} cannot have zero spin. Of fifty-four possibilities considered, it is shown that the following spin and parity assignments are most consistent with available experimental and theoretical evidence from several sources: the ground state of Bi^{212} is 1(−), the 40 keV state of Tl^{208} is 4(+), and the ground state of Tl^{208} is 5(+). These assignments determine the orbital momenta of alpha-particles emitted in the decay of Bi^{212} to be a mixture of 3 and 5 units for the transition to the 40 keV state of Tl^{208} and to be 5 units for the transition to the ground state of Tl^{208}. Using these values of orbital momenta in the Gamow theory, and in the Weisskopf–Devaney theory of alpha fine-structure, the theoretical ratios of decay probabilities for the two groups, $\lambda(40\ keV)/\lambda(0,)$ are found to be in good agreement (10 to 50%) with the observed value. This agreement affords, in the case of Bi^{212}, an explanation for the prohibited decay to the ground state relative to the first excited state found for many non even-even nuclei by Perlman, Ghiorso and Seaborg. Since the emission of the alpha-particle with five units of orbital momentum hinders the decay $Bi^{212} \rightarrow Tl^{208}$ (ground state) by a factor of 16, this helps to explain the unusual size of the "departure factor" (1000) given to this decay by Perman et al. A.

539.165

2355. SEARCH FOR DOUBLE BETA DECAY IN Ca^{48} AND Zr^{96}. M.Awschalom.
Phys. Rev., Vol. 101, No. 3, 1041 (Feb. 1, 1956).

A new search for double beta decay in Ca^{48} and Zr^{96}, using two scintillation detectors in a 4 π solid angle geometry, was performed far underground, in order to reduce the background counting rates to small values in the spectral regions of interest. The results of this experiment showed no evidence for double beta decay in either Ca^{48} or Zr^{96}. Lower limits for the half-lives of these isotopes were estimated as follows: Ca^{48}, $T_{1/2}$ greater than 2×10^{18} yr; Zr^{96}, $T_{1/2}$ greater than 0.5×10^{19} yr. A.

539.165 : 77

2356. THE PHOTOGRAPHIC EFFECTIVENESS OF THE β-RAYS OF Au^{198} AND UX_2. D.T.Elbrus.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 20, No. 2, 87-93 (April, 1955). In German.

The photographic effectiveness is defined as the number of β-rays/mm^2 necessary to produce a certain darkening, and it was measured for two selected films with the above sources. J.Hughes

539.165.2

2357. ON CORRECTIONS FROM MESONS TO THE THEORY OF β-DECAY. S.S.Gershtein and Ya. B.Zel'dovich.
Zh. éksper. teor. Fiz., Vol. 29, No. 5 (11), 698-9 (1955). In Russian.

Corrections from virtual mesons are calculated by Feynman techniques. G.E.Brown

539.165.2

2358. PRESENT STATE OF THE THEORY OF β-DECAY. Ya.B.Zel'dovich.
Uspekhi fiz. Nauk, Vol. 56, No. 2, 165-200 (1955). In Russian.

A review of progress in this field in the last three years. Deals with a selection law for permissible transitions, the properties of various invariants and the analogy of magnetic interaction, the state of light particles formed in β-decay, numerical values of interaction constants, meson corrections

in elementary β-interaction, intermediate particles in the theory of β-decay. 89 refs. C.R.S.Manders

539.165.2

2359. THE BETA DECAY OF THE GROUND STATE OF ^{26}Al. M.J.Laubitz.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1033-6 (Nov., 1955).

The beta-decay spectrum from the ground state of Al^{26} has been observed by means of a scintillation spectrometer. It has an end point of 1.17 ± 0.05 MeV and corresponds to a second forbidden transition, $\Delta J = 3$, no. The beta decay is followed by a gamma ray of energy 1.76 ± 0.1 MeV. A.

539.165.2

2360. SPECTROMETRY OF THE NEUTRINO RECOILS OF ARGON-37. A.H.Snell and F.Pleasonton.
Phys. Rev., Vol. 100, No. 5, 1396-403 (Dec. 1, 1955).

The ions that recoil from neutrino emission in the electron capture decay of A^{37} have been subjected to magnetic spectrometry with a resolution amounting to 2.8% in energy. They are found to have an energy of 9.63 ± 0.06 eV, which is in agreement with the value 9.65 ± 0.05 eV to be expected on the basis of a two-body breakup, the neutrino having an energy of 815 ± 2 keV as determined by others from the threshold of the $Cl^{37}(p, n)A^{37}$ reaction. The momentum balance sets an upper limit of about 10 keV for the rest mass of the neutrino. Auger electron emission following the orbital electron capture leaves the recoils mostly multiply charged, the percentage abundances in charge states 1 to 7 being 6.2 ± 0.1, 15.7 ± 0.4, 39.2 ± 0.5, 26.7 ± 0.4, 10.0 ± 0.2, 1.8 ± 0.1 and 0.4 ± 0.1, respectively. The natural width at half intensity of the singly-charged recoil line is 1.7 eV, which is fully accounted for by the thermal motion of the argon atoms. The natural width of the triply-charged recoil line is 2.5 eV, which is mostly but not entirely accounted for by thermal motion plus recoil from the emission of one 2300 eV K Auger electron. The singly-charged recoils are thought to result from L-capture and from K-capture followed by K X-ray emission, neither of these processes involving recoil from the 2300 eV Auger electron. A.

539.166

2361. GAMMA RADIATION FOLLOWING THE SURFACE SCATTERING OF NUCLEONS. G.R.Satchler.
Proc. Phys. Soc. A, Vol. 68, Pt 11,1037-40 (Nov., 1955).

The nuclear reactions (n, n'), (p, p'), (n, p) and (p, n) are considered to take place by the direct collision of nucleons at the surface of the target nucleus. The angular distribution of any γ-rays following these reactions is considered, and two simple cases presented explicitly. A.

539.166

2362. LOW-ENERGY SCATTERED RADIATION INSIDE A CYLINDRICAL Co^{60} SOURCE. W.Bernstein and R.H.Schuler.
Nucleonics, Vol. 13, No. 11, 110, 112 (Nov., 1955).

NaI spectrometer measurements showed the presence of low energy scattered radiation inside a large hollow radio-cobalt source. The presence of this low energy radiation was found to increase the sensitivity of a methyl iodide chemical dosimeter relative to that of the lower-Z ferrous-oxidation type. Pb screening was found to greatly reduce this effect. L.R.Shepherd

539.166

2363. NEW GAMMA RAYS IN THE NEPTUNIUM-239 DECAY. H.W.Lefevre, E.M.Kinderman and H.H.Van Tuyl.
Phys. Rev., Vol. 100, No. 5, 1374 (Dec. 1, 1955).

Two unreported gamma-rays of energy 0.44 and 0.49 MeV are assigned to Np^{239} by reason of chemical properties and decay constant. The intensities of these gamma-rays relative to a previously reported Np^{239} gamma at 0.334 MeV have been determined to be γ_1(0.33 MeV) : γ_2(0.44 MeV) : γ_3 (0.49 MeV) = 100 : 0.40 : 0.50. Measured yields (gamma-rays per decay) for the 0.44 and 0.49 MeV gammas are 1.6×10^{-4} and 1.9×10^{-4} gamma-rays per decay. It seems probable that both of these gamma-rays originate from a single Pu^{239} level at 0.49 MeV. A.

539.166

2364. ANGULAR DISTRIBUTION OF GAMMA-RAYS IN COULOMB EXCITATION. F.D.Benedict and G.Tice.
Phys. Rev., Vol. 100, No. 5, 1545 (Dec. 1, 1955).

Previous calculations (Abstr. 627/1956) of the angular correlation coefficient a_2 for Coulomb excitation of the 330 keV level in Pt^{194} have been extended to include a_4, and similar calculations have been carried out for the 550 keV level of Cd^{114}. After making a suitable thick target correction, the calculated correlation coefficients are in reasonable agreement with the measured values. J.Hughes

539.166

2365. A HIGH ENERGY γ-RAY IN THE DECAY OF BARIUM 131. R.K.Gupta and S.Jha.
Proc. Phys. Soc. A, Vol. 69, Pt 1, 70-1 (Jan., 1956).

The γ-rays from Ba^{131} decay have been studied with a scintillation spectrometer. The results establish the existence of a 1050 keV γ-ray, of intensity about 4% relative to the known 497 keV γ-ray. J.J.Wilkins

539.166

2366. A MODIFICATION OF THE ONE-PARTICLE FORMULA FOR NUCLEAR GAMMA-RADIATION. P.R.Wallace.
Canad. J. Phys., Vol. 34, No. 1, 62-8 (Jan., 1956).

The one-particle theory of isomeric γ-transitions in nuclei consistently overestimated the probability per unit time of decay. It is shown that, by modifying the one-particle model to take account of the readjustment of the wave functions of all the nuclear particles during the predominantly one-particle transition, satisfactory agreement with experiment can be obtained. The fact that odd-proton transitions are depressed more than odd-neutron ones is attributed to the exchange character of the force giving rise to the readjustment. A.

539.166

2367. DIRECTIONAL CORRELATION OF GAMMA RAYS FROM Sn^{116}. R.P.Scharenberg, M.G.Stewart and M.L.Wiedenbeck.
Phys. Rev., Vol. 101, No. 2, 689-92 (Jan. 15, 1956).

The directional correlations of successive gamma-rays have been measured. Sn^{116} decays via 1.09 MeV-1.27 MeV, 1.49 MeV-1.27 MeV, 0.80 MeV-1.27 MeV and 0.40 MeV-2.09-MeV gamma cascades following beta decay from 54 minute In^{116m}. The measured directional correlation functions are in agreement with those expected for 4(Q)2(Q)0, 4(Q)2(Q)0, 2(10% D, 90% Q, 0^0 phase)2(Q)0 and 2(4% D, 96% Q, 0^0 phase) 2(Q)0 spin sequences respectively. A.

539.166

2368. EVIDENCE FOR THE 258-keV GAMMA RAY OF Sn^{113}. G.Gardner and J.I.Hopkins.
Phys. Rev., Vol. 101, No. 3, 999-1000 (Feb. 1, 1956).

Measurements have shown that there appears to be a 258 keV gamma-ray of Sn^{113} and that its intensity relative to that of the 393 keV gamma-ray is $12\% \pm 2\%$. The half-life for each gamma-ray was measured to be approximately 130 days. A.

539.166

2369. RADIATIVE TRANSITIONS IN LIGHT ELEMENTS. II. D.H.Wilkinson.
Phil. Mag. (Ser. 8), Vol. 1, 127-52 (Feb., 1956).

For Pt I, see Abstr. 8664/1953. A survey is presented of our present knowledge concerning radiative transitions in nuclei of A not more than 20. Over a hundred transitions, chiefly dipole, are analysed in terms of the Weisskopf units, and the following chief conclusions are drawn: (i) El tran-

sitions have a most probable speed of about 0.032 Weisskopf units with a spread in speed of about a factor of seven either way; (ii) The corresponding quantities for M1 transitions are a speed of 0.15 Weisskopf units and a spread of a factor of 20 either way; (iii) These distributions are consistent with shell-model expectations; (iv) If a transition shows $\Gamma_\gamma(eV)/E_\gamma^3(MeV)$ greater than 0.02, then it is very probably E1; (v) There is no clear dependence of transition speed on level spacing or other feature; (vi) Some of the higher multipole transitions are inconsistent with shell model expectation and give evidence of collective motion. A.

539.166

2370. ANGULAR CORRELATION MEASUREMENTS ON ^{88}Sr. C.F.Coleman.
Phil. Mag. (Ser. 8), Vol. 1, 166-74 (Feb., 1956).

Three semi-circular focusing spectrometers, making use of a common magnetic field, have been used to measure the angular correlation of the internal conversion electron pairs produced in the decay of the 1.85 MeV state of Sr^{88}. The results support the assignment 2+ for this state. Similar equipment has been used to measure the angular correlation of certain conversion electron cascades. With a polarimeter having good energy resolution, direction–polarization measurements have been carried out on the 0.90, 1.85 MeV gamma-ray cascade in Sr^{88}. These show that the 1.85 and 2.75 MeV levels in this nucleus have even and odd parity respectively. A.

539.166 : 539.163.2

2371. A SEARCH FOR LOW INTENSITY GAMMA RAYS IN THE ThC.C' AND ThC''.D TRANSITIONS. D.G.E.Martin and G.Parry.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1177-83 (Dec., 1955).

A 180° spectrometer has been used to study the Compton electrons ejected from polythene radiators by the gamma rays from a radio-thorium source, in an attempt to detect gamma rays of low intensity between the energies of 1 MeV and 3.5 MeV. The only gamma rays detected in this region were a gamma ray at 1.62 MeV and the well-known 2.62 MeV ray, the intensity of the 1.62 MeV ray being about 3.5% of the 2.62 MeV ray. Upper limits are estimated for the intensities of gamma rays which have been previously reported by some workers. A possible decay scheme for ThC is discussed. A.

539.166 : 539.172.4

2372. THE γ-RAY SPECTRUM OF FISSION PRODUCTS FROM SLOW NEUTRON IRRADIATION OF URANIUM 235. D.H.Peirson.
Brit. J. appl. Phys., Vol. 6, No. 12, 444-9 (Dec., 1955).

The fission products from uranium 235, irradiated by slow neutrons, have been analysed by a two-crystal γ-ray scintillation spectrometer. The spectrum between one day and seventy days after irradiation has been recorded. The gross spectrum varies with time and consists of two groups of lines around 0.2 and 0.7 MeV, with a single line at 1.58 MeV as the only important component above 1 MeV. By measurement of energy and decay rates seventeen activities, due to fission products of high yield, are identified during the period of analysis. The spectrometer is described and its use as an analytical tool in other applications indicated. A.

539.166.08 : 612

2373. MEDICAL SCINTILLATION SPECTROMETRY. J.E.Francis, P.R.Bell and C.C.Harris.
Nucleonics, Vol. 13, No. 11, 82-8 (Nov., 1955).

A simple NaI scintillation gamma-ray spectrometer employing a single-channel pulse analyser is described. Circuit details are given and two collimators, used to define the beam of radiation to the detector, one giving a flat field, the other producing a focusing effect, are also described. The device makes possible more accurate measurements of radio isotope uptake by counting only in the photopeaks. L.R.Shepherd

539.166.7

2374. RADIAL SPREADING DURING PHOTON DIFFUSION. H.Überall.
Acta phys. Austriaca, Vol. 9, No. 3-4, 324-34 (1955). In German.

The variation of the radial intensity distribution of a parallel beam of gamma rays in traversing matter is calculated. The transport equation is solved by various approximation methods with the restriction $\hbar\omega \ll mc^2$; the intensity distribution is obtained in integral form and numerically evaluated for special cases. J.Hughes

539.166.74

2375. ELASTIC SCATTERING OF GAMMA RAYS. J.R.Cook.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1170-6 (Dec., 1955).

A number of discrepancies appear in the published values for the cross-sections for the elastic scattering of high-energy gamma rays. A direct method, using a scintillation spectrometer, has therefore been developed to measure the cross-section for elastic scattering in terms of the Compton cross-section. This has been done for energies of 0.411, 0.66, 1.17 MeV at an average scattering angle of approximately 80° in lead, tin, copper and mercury. The cross-sections are in agreement with classical prediction in these elements for 0.411 and 0.66 MeV photons. The existence of Delbruck scattering is suggested in the case of 1.17 MeV scattering from lead. A.

539.166.83

2376. MEASUREMENT OF THE K-SHELL CONVERSION COEFFICIENT OF THE 95 keV TRANSITION IN Ho^{166}. T.Stribel.
Z. Naturforsch., Vol. 10a, No. 11, 894 (1955). In German.

Measured with a NaI scintillation spectrometer, by determining the relative intensities of the photopeaks of the K X-rays and the 95 keV γ-ray. The value of the ratio $e_{K/\gamma}$ was 2.90 ± 0.30 which is closest to the theoretical value of 3.0 for an M1 transition. This multipolarity assignment is in agreement with that derived from the K/L ratio and the lifetime of the transition. J.Hughes

539.166.83

2377. K-AUGER ELECTRONS AND CONVERSION ELECTRONS ACCOMPANYING THE DISINTEGRATION $Co^{57} \xrightarrow{K\beta^+} Fe^{57}$. J.B.Bellicard and A.Moussa.
C.R. Acad. Sci. (Paris), Vol. 241, No. 18, 1202-4 (Oct. 31, 1955). In French.

A double-focusing β-spectrometer has been used to determine the energies and intensities of K-Auger groups, K and L conversion groups for the 122 and 136 keV γ-rays, and K, L and M conversion groups for the 14 keV γ-ray. For the 14 keV γ-ray, the values obtained are consistent with theoretical values for M1 transitions. J.J.Wilkins

539.166.83

2378. RECOIL BROADENING OF INTERNAL CONVERSION LINES ASSOCIATED WITH ALPHA DECAY. J.Burde and S.G.Cohen.
Phys. Rev., Vol. 101, No. 1, 495-6 (Jan. 1, 1956).

Measurements on the 'A' and 'F' conversion lines from a thin Th-active deposit have been made with a short-lens spectrometer, at resolution 0.8% (half-width). Significant broadening (to 1.0% half-width) was observed only for the 'A' line (L_1 conversion of the 40 keV transition in ThC''), which is preceded by a 6.04 MeV alpha-decay. Measurements of the 'A' line in 180° coincidence with the 6.04 MeV alpha-particles enabled a recoil shift of 0.24% to be detected. Analysis shows that recoil nuclei stopped in the source backing lose most of their momentum before emitting the conversion electron, indicating a lifetime greater than 2×10^{-13} sec for the 40 keV transition. J.J.Wilkins

539.166.83

2379. CONVERSION OF THE Pt^{196} GAMMA RAYS. M.T.Thieme and E.Bleuler.
Phys. Rev., Vol. 101, No. 3, 1031-3 (Feb. 1, 1956).

The conversion coefficients of the 331 and 354 keV transitions in Pt^{196}, following electron capture of Au^{196}, were measured with the aid of a lens spectrometer adapted for coincidence measurements. The lower, 354 keV, gamma-ray is an E2 transition whereas the K-conversion coefficient of the 331 keV gamma-ray was found to be 18 ± 5% larger than that of a pure E2 transition. From the good agreement of this excess, with that expected for the 4.5% M1 admixture derived from angular correlation measurements (18 ± 2%), it is concluded that the fraction of conversion electrons due to an electric monopole transition is 0 ± 5% (standard error). The intensity ratio of the two transitions is 0.278 ± 0.010. A.

539.166.84

2380. ON THE INTERNAL AND EXTERNAL BREMSSTRAHLUNG FROM S^{35}. H.Langevin-Joliot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 872-5 (Oct. 3, 1955). In French.

Scintillation spectrometer measurements of the internal bremsstrahlung spectrum indicated intensities reaching 4 times the theoretical value for energies above 90 keV. Measurements of external bremsstrahlung spectra produced in C and Al targets, gave excellent agreement with theory. J.J.Wilkins

539.166.84

2381. ON THE INTERNAL AND EXTERNAL BREMSSTRAHLUNG OF Pm^{147} AND OF Pr^{143}. H.Langevin-Joliot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1286-8 (Nov. 7, 1955). In French.

See preceding abstract. Scintillation spectrometer measurements of Pm^{147} and Pr^{143} internal bremsstrahlung spectra indicated intensities reaching about 4.5 and about 2 times theoretical respectively. Measurements of Pm^{147} external bremsstrahlung spectra, produced in C and Al targets, were in agreement with theory. J.J.Wilkins

539.166.84

2382. ON THE BREMSSTRAHLUNG AND AUTOIONIZATION IN THE K SHELL ACCOMPANYING THE DISINTEGRATION OF Pm^{147}. H.Langevin-Joliot.
C.R. Acad. Sci. (Paris), Vol. 241, No. 20, 1390-2 (Nov. 14, 1955). In French.

See preceding abstract. Using a proportional counter, the relative intensities of K-autoionization and bremsstrahlung have been measured. The absolute value (1.25 ± 0.25) x 10^{-4} per disintegration is deduced for K-autoionization. J.J.Wilkins

NUCLEAR REACTIONS 539.17

539.17 : 778.34

2383. EXPERIMENT ON THE MECHANICS OF ATOMIC COLLISIONS. A.G.Barkow.
Amer. J. Phys., Vol. 24, No. 2, 68-70 (Feb., 1956).

A chosen event in a nuclear emulsion is used as the basis of an experiment in a course in modern physics for seniors. It is one of a group of experiments designed to illustrate atomic interactions that has stimulated keen interest among students in nuclear plate work. A.

539.172

2384. POLARIZATION IN NUCLEAR REACTIONS. G.R.Satchler.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1041-4 (Nov., 1955).

Simple formulae are given for the polarization effects, in nuclear reactions, of spin ½ particles and photons, and applied to elastic scattering by a potential well with spin–orbit coupling. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

2385. FISSION OF URANIUM NUCLEI UNDER THE ACTION OF SLOW π^--MESONS, FAST NEUTRONS AND γ-RAYS OF ENERGY UP TO 250 MeV. G.E.Belovitskiĭ, T.A.Romanova, L.V.Sukhov and I.M.Frank.
Zh. eksper. teor. Fiz., Vol. 29, No. 5(11), 537-50 (1955). In Russian.

Events are studied in nuclear emulsions impregnated with uranium salt. The emulsions registered protons of energy less than 30 MeV. The plates were irradiated with π^--mesons and neutrons of maximum energies 180 and 460 MeV, and with γ-rays of maximum energies 30, 80 and 250 MeV. In 96 fissions by π^--mesons, 81 of the cases showed two fragments, 15 showed three. Probability of fission upon capture of a π^--meson is estimated to be about 0.5. Similarly, fissions brought about by high-energy neutrons and γ-rays were analysed. Fission produced by all three of these high-energy agents is sometimes accompanied by a fast proton or α-particle. These, however, carry away only a small part of the energy released and, since the fission fragments have about the same energy distribution as those produced by slow neutrons, it is surmised that most of the energy is taken up in neutron emission. G.E.Brown

539.172

2386. FISSION OF HEAVY NUCLEI BY SLOW π^--MESONS. N.A.Perfilov and N.S.Ivanova.
Zh. éksper. teor. Fiz., Vol. 29, No. 5 (11), 551-8 (1955). In Russian.

Nuclear emulsions impregnated with uranium, lead and tungsten solutions were irradiated by mesons, slowed down to such an energy that most of them stopped in the plates. Probability of fission was highest for uranium, where more than 300 cases were observed. The range distribution of fission fragments showed a single peak. Fission was accompanied in some cases by emission of a proton. These results show that fission brought about by slow π^--mesons is similar to that produced by particles of high (about 100 MeV) energy. G.E.Brown

539.172

2387. π^-–PROTON INTERACTIONS AT 4.5 BeV. G.Maenchen, W.M.Powell, G.Saphir and R.W.Wright.
Phys. Rev., Vol. 99, No. 5, 1619-20 (Sept. 1, 1955).

Some π^-–p interactions obtained in a hydrogen-filled diffusion cloud chamber are reported. 22% are elastic scatterings, 47% are 2-prong inelastic events, 29% are 4-prong and 2% 6-prong. In the 2-prong class, three are known to involve heavy unstable particles, in the 4-prong class one K^+-meson has been identified. Of the two 6-prong events, one involves the production of five or more mesons and the other three or more in the single π^--p interaction. The total cross-section for all processes involving charged outgoing particles is 19.7 ± 3.4 millibarns. D.J.Prowse

539.172

2388. DISINTEGRATIONS PRODUCED IN NUCLEAR EMULSIONS BY 1.5-BeV NEGATIVE PIONS. R.D.Hill, E.O.Salant, M.Widgoff, L.S.Osborne, A.Pevsner, D.M.Ritson, J.Crussard and W.D.Walker.
Phys. Rev., Vol. 101, No. 3, 1127-30 (Feb. 1, 1956).

The stars produced in nuclear emulsions by 1.5 BeV π^- mesons are analysed. The numbers of stars as a function of the numbers of prongs are obtained and compared with stars

produced by protons of similar energies. The angular distributions of prongs from the pion-produced stars are also derived. An example of the decay of a hyperfragment He^{8}* emerging from a pion star is described and the production of K particles by 1.5 BeV pions is noted. A.

539.172

2389. EFFECTS OF SHORT-RANGE CORRELATIONS BETWEEN TWO PROTONS IN ELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY HEAVY NUCLEI. B.W.Downs.
Phys. Rev., Vol. 101, No. 2, 820-5 (Jan. 15, 1956).

An expression is obtained for the leading term in the two-proton contribution to the scattering cross-section, with a two-proton charge density which is a Yukawa function of the separation between two protons. The cross-section for scattering from more complicated charge distributions can be generated from this basic result by differentiation with respect to the Yukawa range parameter. The two-proton cross-section is evaluated for a charge density in which short-range correlations in position between two protons appear. Results are given for the scattering of 600 MeV electrons by heavy nuclei. A.

539.172.1

2390. ON THE TRANSMUTATION OF COPPER BY HEAVY IONS. J.Beydon, R.Chaminade, H.Faraggi, J.Olkowsky, A.Papineau and M.Crut.
J. Phys. Radium, Vol. 16, No. 11, 890-1 (Nov., 1955). In French.

Radioelements of masses between 62 and 77 were prepared by bombardment of Cu with N and O ions (20-60 MeV) from the Saclay cyclotron. Identification was made both chemically and from their decay properties. Relative yields are reported. M.A.Grace

539.172.11

2391. ELASTIC SCATTERING OF 48-MeV ALPHA PARTICLES. R.E.Ellis and L.Schecter.
Phys. Rev., Vol. 101, No. 2, 636-44 (Jan. 15, 1956).

The angular distributions of alpha-particles scattered elastically from Ag, Au and Pb targets have been measured. Deviations by three to four orders of magnitude from pure Coulomb scattering have been observed beyond the forward angles. In addition, some regular structure appears in these distributions, but the main features can be described by an exponential falloff between 25° and 90°. By fitting the data with a simple modification of Blair's scattering theory, it has been possible to determine interaction radii. Nuclear radii have been derived which are in agreement with those found from medium-energy nucleon scattering. A.

539.172.11

2392. (α, n) TYPE REACTIONS IN LIGHT NUCLEI. A.R.Quinton and W.T.Doyle.
Phys. Rev., Vol. 101, No. 2, 669-72 (Jan. 15, 1956).

Two independent methods utilizing a recoil proton telescope and a neutron threshold detector have been used to study a series of (α, n) reactions. The following Q values have been observed: $B^{10}(\alpha, n)N^{13}$ – 3.85 ± 0.3, (– 3.2 ± 0.3), – 2.5 ± 0.3, –1.3 ± 0.3 MeV; $B^{11}(\alpha, n)N^{14}$ – 4.8 ± 0.3, – 3.85 ± 0.3, – 3.15 ± 0.3, – 2.0 ± 0.3, 0.0 ± 0.3 MeV; $F^{19}(\alpha, n)Na^{22}$ – 5.0 ± 0.2, – 4.25 ± 0.2, – 3.8 ± 0.2, – 3.15 ± 0.2, – 2.45 ± 0.2, – 2.0 ± 0.2 MeV; $P^{31}(\alpha, n)Cl^{34}$ – 5.7 ± 0.2 MeV. An excitation function has also been obtained for the 1.58 sec β^{+} activity in Cl^{34} with an observed threshold at – 5.7 ± 0.3 MeV. A.

539.172.11

2393. $B^{10} + \alpha$ REACTIONS. G.F.Pieper and G.S.Stanford.
Phys. Rev., Vol. 101. No. 2, 672 (Jan. 15, 1956).

An investigation of the $B^{10}(\alpha, p)C^{13}$ reaction has shown no evidence for the occasionally reported levels in C^{13} at 0.7 MeV and 4.4 MeV. The latter level may in the past have been confused with the ground-state transition in the $B^{10}(\alpha, d)C^{12}$ reaction. A.

539.172.11

2394. SCATTERING OF 22-MeV ALPHA PARTICLES BY N^{14}. D.W.Miller, B.M.Carmichael, U.C.Gupta, V.K.Rasmussen and M.B.Sampson.
Phys. Rev., Vol. 101, No. 2, 740-5 (Jan. 15, 1956).

The inelastic scattering has been investigated and previously unreported levels at 7.94 ± 0.07, 8.45 ± 0.07 and 10.05 ± 0.07 MeV in N^{14} were observed. Levels at 2.31, 7.4, 7.7, 8.06 and 9.49 MeV reported in other reactions were not observed. This confirms the isotopic spin T = 1 assignment to the 2.31 and 8.06 MeV levels, and suggests such an assignment for the 9.49 MeV level. The status of the 7.4 and 7.7 MeV levels is uncertain. A.

539.172.11

2395. $N^{14}(\alpha, n)F^{17}$ AND $Na^{23}(\alpha, n)Al^{26}$ REACTIONS. W.T.Doyle and A.B.Robbins.
Phys. Rev., Vol. 101, No. 3, 1056-8 (Feb. 1, 1956).

These reactions have been studied by two methods, a proton recoil telescope and a slow neutron threshold detector. An energy level in F^{17} at 0.54 ± 0.04 MeV has been observed and a ground state Q value of –4.76 ± 0.07 MeV was determined. Energy levels in Al^{26} were found at 0.3, 1.0, 1.4, 1.8, 2.5 and 2.9 ± 0.2 MeV and a ground-state Q value of –2.9 ± 0.2 MeV was determined. In the latter reaction an excitation curve of the 7 sec beta activity in Al^{26} has been observed with a threshold Q of –3.2 ± 0.2 MeV, indicating the presence of an isomeric state in Al^{26} at about 300 keV. A.

539.172.13

2396. ON THE PROBLEM OF THE ANGULAR DISTRIBUTION OF URANIUM FISSION FRAGMENTS AT HIGH EXCITATION ENERGIES. O.V.Lozhkin, N.A.Perfilov and V.P.Shamov.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 292-5 (1955). In Russian.

Nuclear emulsions soaked in solutions of uranium salts are bombarded by 660 MeV protons. The distribution of resulting fragments can be described by $N_{\phi}/N_{0} = 1 + 0.29 \sin^{4}\phi$ where ϕ is the angle between the projection of the fragment on the horizontal plane of the plate and the incident particles. Dependence of the anisotropy on the energy of excitation of the nucleus is studied. G.E.Brown

539.172.13

2397. ON THE EMISSION OF LOW ENERGY α-PARTICLES BY LIGHT AND HEAVY NUCLEI EXCITED BY 1000 MeV PROTONS. G.Philbert.
C.R. Acad. Sci. (Paris), Vol. 241, No. 14, 875-7 (Oct. 3, 1955).

A study of the stars produced by 1000 MeV protons in normal and diluted emulsions shows that an alpha-particle of energy less than 8 MeV is emitted in 50% of the light nuclear events, and in 14% of the heavy nuclear events. J.M.Cassels

539.172.13

2398. PROPERTIES OF NUCLEAR DISINTEGRATION STARS IN DILUTED EMULSIONS EXPOSED TO 1000 MeV PROTONS. G. Philbert.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 944-7 (Oct. 10, 1955). In French.

A study of the characteristics of stars caused by the interaction of 1 BeV protons with nuclei in G.5 2x and G.5 4x (2 and 4 times the normal gelatine content) emulsions. Some very general results are deduced on the interactions with light nuclei. The mean number of charged particles emitted in the disintegrations are sensibly the same for light and heavy nuclei. A number of 'heavy' stars have more than 8 prongs; these are probably due to mesic emission followed by absorption. This process plays a much less important role in the formation of the 'light' stars. D.J.Prowse

539.172.13

2399. THE ANGULAR DISTRIBUTION OF α-PARTICLES FROM THE REACTION $^{19}F(p\,\alpha)^{16}O^*(\pi)^{16}O$. A.Isoya, K.Goto and T.Momota.
J. Phys. Soc. Japan, Vol. 10, No. 11, 1022 (Nov., 1955).

The angular distribution of alpha-particles corresponding to the pair-emitting state in O^{16} was measured at the 873 keV resonance in fluorine. The result obtained was $W(\theta)$ $1 + 0.47\cos\theta - 0.30\cos^2\theta - 0.014\cos^3\theta + 0.59\cos^4\theta$. The alpha-particles were distinguished from the α_1, α_2, α_3, groups by a coincidence method, using Geiger counters to detect the pair electrons and a proportional counter to detect the alpha-particles. D.R.Chick

539.172.13

2400. THE PRODUCTION OF ^{11}C FROM CARBON BY PROTONS OF ENERGY BETWEEN 200 AND 950 MeV. W.E.Burcham, J.L.Symonds and J.D.Young.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1001-7 (Nov., 1955).

Polystyrene disks were irradiated in the scattered proton beam of the Birmingham synchrotron. The proton flux was found by counting tracks in a nuclear emulsion exposed near the polystyrene disk. From the observed activity of the disks the cross-section for the production of 20.5 minute C^{11} from carbon by 950 MeV protons was found to be 20.5 ± 1.1 mbn. The variation of cross-section over the energy range 200-950 MeV was also studied. A.

539.172.13

2401. EXCITATION FUNCTIONS UP TO 980 MeV FOR PROTON-INDUCED REACTIONS IN ^{27}Al, RELATIVE TO $^{12}C(p, pn)^{11}C$. G.A Chackett, K.F.Chackett, P.Reasbeck, J.L.Symonds and J.Warren.
Proc. Phys. Soc. A., Vol. 69, Pt 1, 43-8 (Jan., 1956).

The activities produced in the bombardment of aluminium with protons in the energy range 200-980 MeV have been studied. The ratio of the cross-section for the production of C^{11} from polythene to that for both F^{18} and Na^{24} from aluminium are given in this energy range while cross-section ratios of Mg^{27}, N^{13} and C^{11} from aluminium are given at an energy of 980 MeV. A.

539.172.13

2402. INELASTIC SCATTERING OF 31-MeV PROTONS FROM BERYLLIUM. J.Benveniste, R.G.Finke and E.A.Martinelli.
Phys. Rev., Vol. 101, No. 2, 655-62 (Jan. 15, 1956).

The range spectrum of charged particles resulting from the bombardment of a thin beryllium foil by 31.3 MeV protons was measured at several angles. In addition to previously reported energy levels in Be^9 at 2.4, 6.8 and 11.3 MeV, evidence for new levels at 5.0, 7.9, 19.9 and 21.7 MeV was obtained. The angular distribution of each of the proton groups was interpreted in the light of the Austern-Butler-McManus peripheral scattering theory. Deuteron groups corresponding to the Be^8 ground state and first excited states were also identified. The angular distribution of the ground state deuteron group agrees well with the prediction of a modified Butler theory for the (p,d) reaction. A.

539.172.13

2403. ANGULAR DISTRIBUTION OF NEUTRONS FROM $O^{18}(p, n)F^{18}$. H.Mark and C.Goodman.
Phys. Rev., Vol. 101, No. 2, 768-71 (Jan. 15, 1956).

This reaction has been studied using monoenergetic protons from an electrostatic generator. Resonances in the neutron yield in the forward direction were found at energies E_p = 2.657, 2.732, 2.778, 3.045, 3.170, 3.268, 3.386, 3.495, 3.600 and 3.755 MeV. The angular distribution of neutrons from this reaction at proton energies E_p = 3.045, 3.170, 3.268 and 3.386 MeV has been measured with a proton recoil counter. The most probable values of the spins of the excited states in F^{19} corresponding to these resonances are $J = \frac{3}{2}^+, \frac{1}{2}^-, \frac{3}{2}^+$, and $\frac{1}{2}^+$ respectively. A.

539.172.13

2404. LOW-LYING LEVELS OF P^{30}. C.Broude, L.L.Green, J.J.Singh and J.C.Willmott.
Phys. Rev., Vol. 101, No. 3, 1052 (Feb. 1, 1956).

New states in P^{30} are identified by determination of gamma-ray energies from the reaction $Si^{29}(p, \gamma)P^{30}$. The angular distributions of transitions to the ground and first excited states have been determined and spins and parities assigned on the basis of these measurements. The first excited state is thus identified as the first T = 1 state of P^{30}. A.

539.172.13

2405. NEUTRON GROUPS FROM DEUTERON STRIPPING BY ^{23}Na, ^{27}Al AND ^{31}P. J.M.Calvert, A.A.Jaffe, A.E.Litherland and E.E.Maslin.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1008-16 (Nov., 1955).

Using a triple ionization chamber to collimate and record recoil protons from a hydrogenous radiator, angular distribution measurements have been carried out on a number of neutron groups emitted as a result of the bombardment by 9 MeV deuterons of targets of sodium carbonate, aluminium and phosphorus. Spins and parities of the resulting states of the 4n nuclei Mg^{24}, Si^{28} and S^{32} have been assigned by applying the theory of the stripping process. In the case of Si^{28}, the first T = 1 level is identified and its characteristics compared with those of the ground state of Al^{28}. Á.

539.172.13

2406. AN INVESTIGATION OF THE REACTION $^{19}F(d, n)^{20}Ne$ USING A NEW FAST-NEUTRON SPECTROMETER. J.M.Calvert, A.A.Jaffe and E.E.Maslin.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1017-25 (Nov., 1955).

A description is given of a new fast-neutron spectrometer which utilizes scintillation counters and which has a relatively high efficiency of detection. The instrument is suitable for use at neutron energies of 4 MeV and above and has been used to investigate the stripping reaction $F^{19}(d, n)Ne^{20}$. The angular distribution of four neutron groups has been found and the theory of the deuteron stripping process has been applied to analyse the results and to obtain information about the corresponding levels in Ne^{20}. A.

539.172.13

2407. REDUCED WIDTH FROM STRIPPING REACTIONS. J.M.Calvert, A.A.Jaffe and E.E.Maslin.
Phys. Rev., Vol. 101, No. 1, 501-2 (Jan. 1, 1956).

The cross-sections for (d, p) and (d, n) reactions are compared as closely as possible in a single experiment. The ratio of the reduced widths for reactions leading to corresponding levels in mirror nuclei do not show any systematic departure from unity. J.M.Cassels

539.172.13

2408. ANGULAR DISTRIBUTION OF PROTON GROUPS FROM THE REACTION $F^{19}(d, p)F^{20}$. S.Takemoto, T.Dazai, R.Chiba, S.Suganomata and S.Ito.
Phys. Rev., Vol. 101, No. 2, 772-4 (Jan. 15, 1956).

The angular distribution of proton groups from $F^{19}(d, p)F^{20}$ has been studied by means of nuclear emulsion with deuterons of energy 0.75 to 1.45 MeV. Distributions were found for each of three proton groups from fluorine, corresponding to the ground state (P_0), 0.65 MeV (P_1), and 0.99 MeV (P_3) + 1.06 MeV (P_4) level in F^{20}, respectively. Group P_1 and $P_3 + P_4$ show stripping effect, and from a Butler analysis, l_n-values for these groups are 2 and 0, respectively. In the case of group P_0, the stripping effect is obscure, A.

539.172.3

2409. THEORY OF PHOTONUCLEAR REACTIONS. I. NUCLEAR MODEL. A.Herpin and C.Mercier.
C.R. Acad. Sci. (Paris), Vol. 241, No. 15, 947-9 (Oct. 10, 1955). In French.

See Abstrs. 1715 (1954) and 8989 (1955). Some properties

of the complex potential model are discussed. For a particular choice of the potential, the equivalent of a black (strongly absorbing) nucleus is obtained for certain discrete energy values. J.J.Wilkins

539.172.3

2410. (γ, p) REACTION IN ARGON-40. B.M.Spicer.
Phys. Rev., Vol. 100, No. 3, 791-6 (Nov. 1, 1955).

The energy distribution and angular distribution of photoprotons from argon irradiated with 22.5 MeV bremsstrahlung have been measured. The yield of protons was found to be 6.6×10^5 protons per mole per r, in good agreement with other results. The angular distribution of protons indicated that the absorption was predominantly electric dipole, as expected. The energy distribution peaked at 2.6 MeV, and, from its characteristics, it was inferred that the Coulomb barrier for protons plus Cl^{39} was only about 2.5 MeV, and that the level density in Cl^{39} increased with energy approximately as exp(E). These results are discussed in terms of the compound nucleus model and the direct photoeffect model. A.

539.172.3

2411. $C^{12}(\gamma, n)$ YIELD CURVE NEAR THRESHOLD.
B.M.Spicer and A.S.Penfold.
Phys. Rev., Vol. 100, No. 5, 1375-6 (Dec. 1, 1955).

The yield curve has been studied near the threshold for the reaction with a 22 MeV betatron. A discontinuity in slope, or "break", is observed to occur 370 keV above the threshold. This is in disagreement with previously published results. The discrepancy is important since it indicates a disagreement in the measurement of the $C^{12}(\gamma, n)C^{11}$ threshold, and this threshold is used to establish the energy calibration of the betatron. A.

539.172.3

2412. ISOBAR ROLE IN TWO-NUCLEON PROCESSES: DEUTERON PHOTOEFFECT. N.Austern.
Phys. Rev., Vol. 100, No. 5, 1522-9 (Dec. 1, 1955).

An elementary model of the $\frac{3}{2}, \frac{3}{2}$ nucleon isobar is applied literally as an intermediate state in two-nucleon processes. The mechanism of deuteron photodisintegration which is thus implied is found to contribute most of the observed cross-section at high energy. The isobar does not seem to be as important in nucleon-nucleon scattering, or in reducing the photomeson production (and similar processes) below the estimates of impulse approximation. An estimate of single-nucleon Compton effect also is given, in the context of the isobar model. A.

539.172.3

2413. PHOTONEUTRONS FROM U^{233} AND Pu^{239} FISSION PRODUCTS IN HEAVY WATER. S.Bernstein, J.K.Leslie, C.R.McKinney and H.K.Jackson.
J. appl. Phys., Vol. 27, No. 1, 23-4 (Jan., 1956).

The yield of photoneutrons from U^{238}, U^{233} and Pu^{239} fission products in heavy water are compared. The number of photoneutrons per delayed neutron was found to be approximately the same for all three, in spite of the previously known large variations in the relative numbers of delayed neutrons from these isotopes. A.

539.172.3

2414. $(\gamma, p+\alpha)$ REACTIONS PRODUCED IN PHOTOGRAPHIC EMULSIONS. D.L.Livesey.
Canad. J. Phys., Vol. 34, No. 2, 216-22 (Feb., 1956).

Ilford C.2 plates were exposed to bremsstrahlung of maximum energy 70 MeV from an electron synchrotron, and 82 stars produced in the emulsion have been attributed to the reaction: $C^{12} + h\nu = H^1 + He^4 + Li^7 - 24.6$ MeV. The excitation function of the reaction shows a sharp drop near 40 MeV and the integrated cross-section up to this limit has been estimated. In addition 23 stars have been identified as being due to the reaction: $N^{14} + h\nu = H^1 + He^4 + Be^9 - 18.2$ MeV. In both reactions the most probable mode of disintegration is by the initial emission of an alpha-particle. The range measurements in the carbon stars have been used to derive an accurate range–energy relation for lithium ions in nuclear emulsion. A.

539.172.4

2415. RADIATION WIDTHS IN SLOW NEUTRON RESONANCES. H.H.Landon.
Phys. Rev., Vol. 100, No. 5, 1414-18 (Dec. 1, 1955).

A summary of current measurements of total radiation widths as observed in slow neutron resonance capture is presented together with the most recent data for a number of resonances in iridium, lutetium and tungsten. The general features of the dependence of radiation width upon atomic weight is discussed in terms of a model proposed by Blatt and Weisskopf. A.

539.172.4

2416. ELASTIC SCATTERING OF NEUTRONS BY Li^6 AND Li^7. H.B.Willard, J.K.Bair, J.D.Kington and H.O.Cohn.
Phys. Rev., Vol. 101, No. 2, 765-8 (Jan. 15, 1956).

Differential cross-sections for elastic scattering of neutrons by Li^6 and Li^7 have been measured in the region of 200 to 600-keV incident energy. The results for Li^6 confirm the assignment of $5/2^-$ for the 7.46 MeV level in Li^{7*} and indicate that the s-wave potential scattering has a statistical channel spin mixture and negative phase shift. Similarly in the case of Li^7, the 2.28 MeV level in Li^{8*} is indeed 3^+, the s-wave potential scattering has very nearly a statistical channel spin mixture, but the phase shift is positive. A.

539.172.4

2417. CLOUDED CRYSTAL BALL ANALYSIS OF THE INELASTIC SCATTERING CROSS SECTION OF A NEUTRON INTO THE ISOMERIC LEVEL $(13/2^+)$ OF $_{82}Pb^{207}$. S.Oleksa.
Phys. Rev., Vol. 101, No. 3, 1034-8 (Feb. 1, 1956).

The clouded crystal ball model was used in the calculation of the cross-section for excitation of the 0.8 sec metastable state of $_{82}Pb^{207}$ (Stelson and Campbell's experimental data). Values of X_0^2 were varied from 140 to 172, two values of ζ were considered, $\zeta = 0.03$ and $\zeta = 0.05$, and two values of the radius, $R = 1.45A^{1/3} \times 10^{-13}$ cm and $R = (1.27A^{1/3} + 0.7) \times 10^{-13}$ cm. The clouded crystal ball model and the strong-interaction model both fit the experimental data. The former, however, is extremely sensitive to changes in the parameter X_0^2. The radius $R = 1.45A^{1/3} \times 10^{-13}$ cm fits the data better than $R = (1.27A^{1/3} + 0.7) \times 10^{-13}$ cm. A.

539.172.4

2418. NEGATIVE PIONS FROM NEUTRON BOMBARDMENT OF DEUTERONS. M.W.Knapp and W.M.Powell.
Phys. Rev., Vol. 101, No. 3, 1110-15 (Feb. 1, 1956).

In order to obtain information on the neutron-neutron interaction, a cloud chamber filled with deuterium gas was bombarded with the neutron beam of the 184 in. synchrocyclotron. The spectrum of the neutron beam, which is produced by 340 MeV protons on a 2.5 in. lithium deuteride target, is peaked at 300 MeV and extends to 340 MeV. The three reactions $d(n, \pi^- p)d$, $d(n, \pi^- pn)p$, and $d(n, \pi^-) He^3$ were studied. A total of 310 events were examined; the three reactions contributed 208, 80 and 22 events respectively. Laboratory-system angular distributions and energy spectra of the mesons are presented. Comparisons with theory indicate agreement with the predictions of the charge-independence hypothesis. A.

539.172.4 : 539.152.1

2419. A CONTRIBUTION TO THE THEORY OF NEUTRON REACTIONS. Z.Janković.
Period. math. phys. astron. (Zagreb), Vol. 10, No. 1-2, 47-62 (1955).

Description of calculations (for s neutrons) of total cross-

sections and average level width divided by level spacing, on the basis of the cloudy crystal ball model of Feshbach, Porter and Weisskopf, but using a potential with a linearly sloping surface region of thickness 0, 1 or 2 x 10^{-13} cm. Real depths of 30, 35 and 42 MeV and 3 different values of the complex depth were used. For results see also Abstr. 5582 (1955).
W.J.Swiatecki

539.172.4 : 539.166

GAMMA RAYS FROM INELASTIC NEUTRON SCATTERING. See Abstr. 1539.

539.172.4

2420. FISSION-NEUTRON REACTION CROSS SECTIONS. W.Inthoff.
Nucleonics, Vol. 13, No. 11, 67 (Nov., 1955).

Nomograms are given, relating the cross-sections for (n, p) and (n, α) reactions in a fission-neutron spectrum, the Z and A of the target nucleus and the threshold energies of the reactions. L.R.Shepherd

539.172.4

2421. STUDY OF THE VARIATION OF THE MEAN NUMBER OF NEUTRONS PRODUCED IN THE FISSION OF Pu^{239}. J.M.Auclair, H.H.Landon and M.Jacob.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1935-6 (Dec. 19, 1955). In French.

The number is constant to 1% for neutron energies between the thermal region and 0.35 eV. J.M.Cassels

539.172.4

2422. EMISSION OF PROMPT NEUTRONS FROM FISSION. R.B.Leachman.
Phys. Rev., Vol. 101, No. 3, 1005-11 (Feb. 1, 1956).

An analysis of the total energies of the fragment pairs from fission is used with the mass equation of fission to estimate the distributions in the excitation energy of the fragments from spontaneous and neutron-induced fission of several nuclides. These excitations are used with simple neutron boil-off considerations to calculate the probabilities of emission of 0, 1, 2, 3 ... prompt neutrons. The calculated results are in good agreement with recent measurements. The same excitation energy distributions and neutron boil-off considerations are used with an assumption of an isotropic angular relation between the fragments and the emitted neutrons to calculate the energy spectrum of neutrons from thermal and 3 MeV neutron-induced fission of U^{235}. For thermal-neutron fission, the calculated spectrum is in fair agreement with recent measurements. The calculations indicate little change in the spectrum for 3 MeV fission. The average energy of the prompt gamma-rays is 3.8 MeV from this analysis. A.

539.172.4

2423. MULTIPLICITIES OF FISSION NEUTRONS. B.C.Diven, H.C.Martin, R.F.Taschek and J.Terrell.
Phys. Rev., Vol. 101, No. 3, 1012-15 (Feb. 1, 1956).

A large liquid scintillator with approximately 80% efficiency for detection of neutrons has been used to obtain data on numbers of neutrons emitted per fission for several fissioning nuclides. Reported here are the average number of neutrons per fission, $\bar{\nu}$, and the respective probabilities of 0, 1, 2, ... neutrons per fission, for spontaneous fission of Pu^{240}, Cm^{244} and Cf^{252}, and for fission induced in U^{233}, U^{235} and Pu^{239} by 80 keV neutrons. The values of $\bar{\nu}$ for these cases are, respectively, 2.257 ± 0.045, 2.810 ± 0.059, 3.869 ± 0.078, 2.585 ± 0.062, 2.47 ± 0.03 and 3.048 ± 0.079. The thermal neutron value for U^{235} (2.46 ± 0.03), obtained by other methods, was used here as a standard for calibrating the detector efficiency. The efficiency was also measured by another method, involving scattering neutrons into the scintillator, with results in good agreement. The probabilities of 0, 1, 2, ... neutrons per fission approach closely a binomial type distribution, with the maximum number of neutrons equal to 5, 6, or 7, depending on $\bar{\nu}$. A.

539.172.4

2424. PROBABILITIES OF PROMPT-NEUTRON EMISSION FROM SPONTANEOUS FISSION. D.A.Hicks, J.Ise, Jr and R.V.Pyle.
Phys. Rev., Vol. 101, No. 3, 1016-20 (Feb. 1, 1956).

The neutron number distributions from the spontaneous fission of seven isotopes have been measured by use of a cadmium-loaded liquid scintillation tank. The experimental distributions can be roughly approximated by binomial distributions. The average number of neutrons per spontaneous fission have been found to be 2.30 ± 0.19 for Pu^{238}, 2.33 ± 0.08 for Pu^{238}, 218 ± 0.09 for Pu^{242}, 2.65 ± 0.09 for Cm^{242}, 2.84 ± 0.09 for Cm^{244} and 3.82 ± 0.12 for Cf^{252}, all based on 2.257 ± 0.046 for Pu^{240}. A.

539.172.4 : 537.214

2425. DEFORMATION ENERGY OF A CHARGED DROP. I. QUALITATIVE FEATURES. W.J.Swiatecki.
Phys. Rev., Vol. 101, No. 2, 651-4 (Jan. 15, 1956).

The qualitative features of the deformation energy of a charged drop are discussed with special reference to the fission process. It is shown that, under conditions more general than the model of an incompressible liquid drop with a sharp surface, the threshold energy for fission should be proportional to $[(Z^2/A)_0 - (Z^2/A)]^3$ near the limit of stability $(Z^2/A)_0$. Similarly, if instability against asymmetry sets in below $(Z^2/A)_C$, the degree of asymmetry of the asymmetric saddle-point shapes which appear should be proportional to $[(Z^2/A)_C - (Z^2/A)]^{1/2}$ and the difference between the symmetric and asymmetric thresholds should be proportional to $[(Z^2/A)_C - (Z^2/A)]^2$. Some factors governing the stability against asymmetry of strongly deformed drop are discussed qualitatively. A.

539.172.4

2426. ATOMS FOR PEACE.
Nucleonics, Vol. 13, No. 9, 34-101 (Sept., 1955).

Papers presented at the International Conference on the Peaceful Uses of Atomic Energy, held at Geneva in August, 1955, are reviewed. The material covers economic aspects of nuclear power; demonstration power reactors and research reactors at present in operation, under construction, or still in the design stage; metallurgy and chemical engineering aspects of reactor fuels, moderator canning and structural materials; neutronic data on fissile materials and other important isotopes; nuclear instrumentation and techniques; uses of radio-isotopes. L.R.Shepherd

539.172.4

2427. SEPARATING AND PURIFYING REACTOR FUEL FROM URANIUM-ORE CONCENTRATES. W.E.Kelley.
Nucleonics, Vol. 13, No. 11, 68-71 (Nov., 1955).

The operations involved in processing ore concentrates to produce UF_6 for diffusion plants or pure U metal for nuclear reactors, are outlined briefly. The similarity between the production of U, Th, Ti and Zr is indicated. Possible improvements and future developments in the processing of these metals are noted. L.R.Shepherd

539.172.4

2428. TEST TUBE RESEARCH REACTOR. H.M.Busey and R.P.Hammond.
Nucleonics, Vol. 13, No. 11, 72-5 (Nov., 1955).

The reactor is of the aqueous homogeneous type in which the hot liquid rises by natural convection through a vertical tube above the critical region. The return flow carries the liquid downward through an annular space around this tube that contains the heat exchanger coils through which cooling water circulates. The reactor is self stabilizing, relying upon the negative temperature coefficient of reactivity to limit power output. The radiolytic gases are recombined by platinum-black coated alumina cylinders mounted in a convection chimney above the surface of the liquid fuel. The whole assembly

is inside a test tube shaped container, with a control-curtain made from a suitable neutron absorber sliding between the outside of the tube and the surrounding reflector. A central flux of 5×10^{12} n.cm^{-2} sec^{-1} is obtainable at 100 kW.

L.R.Shepherd

539.172.4

2429. REPORT ON REACTOR CONSTRUCTION. P.R.Arendt.
Z. angew. Phys., Vol. 8, No. 1, 41-7 (1956). In German.

Brief technical descriptions with diagrams are given of the high-power reactors which were reported at the Geneva Conference by Britain, America and Russia. J.Hughes

539.172.4

2430. THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY AND ITS FUNCTIONS. J.Cockcroft.
Brit. J. appl. Phys., Vol. 7, No. 2, 43-51 (Feb., 1956).

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

2431. HEAVY UNSTABLE PARTICLES (HYPERONS AND K-MESONS). A.O.Vaĭsenberg.
Uspekhi fiz. Nauk, Vol. 57, No. 3, 361-434 (1955). In Russian.

The first half of a two-part article. There is a good account of experimental methods, methods of analysing observations and some description of V_1^0 particles, neutral hyperons Λ^0, V_2^0 mesons, θ^0 mesons, charged hyperons. 118 refs. C.R.S.Manders

539.18

2432. HEAVY UNSTABLE PARTICLES (HYPERONS AND K-MESONS). A.O.Vaĭsenberg.
Uspekhi fiz. Nauk, Vol. 57, No. 4, 631-89 (1955). In Russian.

Continuation of paper reported in preceding abstract. Deals in exhaustive fashion with charged K-mesons, $V^{\pm}$ particles, the generation of hyperons and K-mesons and their interaction with nuclei. A further 63 refs. C.R.S.Manders

539.18

2433. ON THE FERMI–YANG HYPOTHESIS. S.S.Filippov.
Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 707-8 (1955). In Russian.

It may be possible to consider mesons other than the π-meson as bound states of the nucleon and anti-nucleon.

G.E.Brown

539.18

2434. THE PRODUCTION OF A PAIR OF HEAVY MESONS IN A HIGH ENERGY NUCLEAR INTERACTION. M.W.Friedlander, D.Keefe and M.G.K.Menon.
Nuovo Cimento (Ser. 10), Vol. 2, No. 3, 666-8 (Sept., 1955).

An event is reported in which a negative K-meson is produced in association with another heavy meson. The K^--capture star, which was found during routine scanning, had two branches, one a π-meson of 53 MeV and the other a charged hyperon which decayed when at rest or nearly at rest into a π-meson of 82 MeV. If one assumed it was at rest the Q-value for the decay mode, $Y \rightarrow n + \pi^{\pm} + Q$, is 98 ± 4 MeV. It is therefore probably an example of the decay in flight of a Σ-particle which still had a residual range of 200μ. The parent star of the K^--meson was analysed and another K-meson found which by $(\bar{\sigma}, g^*)$ measurements had a mass value of 875 ± 65 m_e. The angle between the pair of K-mesons was 68° and the total visible energy of the parent star 3.5 GeV.

D.J.Prowse

539.18

2435. ASSOCIATED PRODUCTION OF Ξ^- WITH TWO θ^0 PARTICLES. J.D.Sorrels, R.B.Leighton and C.D.Anderson.
Phys. Rev., Vol. 100, No. 5, 1457-9 (Dec. 1, 1955).

A cosmic-ray event is described in which a negative cascade particle and two neutral heavy mesons appear to be produced in a single nuclear interaction above a cloud chamber. It is suggested that this event may be an example of the associated production of a Ξ^- particle with two θ^0 particles according to the scheme of Gell-Mann. A.

539.18

2436. CLOUD-CHAMBER INVESTIGATION OF CHARGED V PARTICLES. G.H.Trilling and R.B.Leighton.
Phys. Rev., Vol. 100, No. 5, 1468-75 (Dec. 1, 1955).

An analysis of 84 charged V events obtained during two years of operation of a vertical magnetic cloud-chamber array is presented. The particular features of interest which are studied in detail are the distribution of P*, the momentum of the charged secondary in the rest system of the primary, and the possible existence of a component of short lifetime (i.e., $\tau < 5 \times 10^{-10}$ sec). The P* distribution from 19 slow, accurately measurable positive events is shown to imply that the large majority of these events arise from one or more two-body decays from primaries of mass approximately equal to that of the τ-meson. One case turns out to be inconsistent with this interpretation, and is presumed to represent a three-body decay. The P* distribution from 6 slow, accurately measurable negative events is consistent with a single two-body decay having a P* value of about 200 MeV/c. This suggests the existence of a negative counterpart to the well-known θ^0 particle, though the statistics are much too poor to permit any strong conclusion. The lifetime analysis provides strong evidence of a negative component of lifetime equal to or less than $(1.3 \pm 0.6) \times 10^{-10}$ sec. The transverse momentum distribution for these short-lived events is shown to suggest a two-body decay with a P* value of 201 ± 12 MeV/c. A.

539.18

2437. SELECTION RULES FOR DECAYS INTO MORE THAN TWO BOSONS. B.Jakšić.
Period. math.-phys. astron. (Zagreb), Vol. 10, No. 1-2, 65-70 (1955).

An extension of the previous work on two-boson decays (Abstr. 2025/1954; 4090 and 4953/1955) for decays into 3 polarized particles. It is further shown that for decays into more than 3 particles of spin 0 or 1, no selection rules exist.

J.Hughes

539.18

2438. BRANCHING RATIOS IN HYPERON AND HEAVY-MESON DECAYS. G.Wentzel.
Phys. Rev., Vol. 101, No. 1, 505-6 (Jan. 1, 1956).

Branching ratios of λ, Σ and β particles are considered with the simplifying assumption that only certain selected decay processes are truly elementary while the others are indirect, higher order processes. The various possibilities introduced by this hypothesis are shown to be most unlikely unless the θ-particle has even parity and spin.

A.J.Egginton

539.18

2439. CHARACTERISTICS OF K^+-PARTICLES. D.M.Ritson, A.Pevsner, S.C.Fung, M.Widgoff, G.T.Zorn, S.Goldhaber and G.Goldhaber.
Phys. Rev., Vol. 101, No. 3, 1085-93 (Feb. 1, 1956).

A large nuclear emulsion stack was exposed in the magnetically analysed beam of K^+ particles, at the Berkeley Bevatron. The secondaries of stopped K-mesons have been analysed, and examples of all the known modes of decay: $K_{\mu 2}$, $K_{\pi 2}$, K_{e3}, $K_{\mu 3}$, τ and τ' have been identified. The decay processes of the $K_{\mu 2}$, $K_{\pi 2}$ and τ' mesons have been confirmed, and a possible decay scheme for the $K_{\mu 3}$ has been

considered. The masses of the particles decaying in the different ways have been determined from momentum-range measurements, and for $K_{\mu 2}$ and $K_{\pi 2}$ particles, from the Q of the decay as well. The masses of all the particles are consistent with a value of 965 m_e, within about 10 m_e. The relative frequencies of the various modes of decay have been estimated, and by comparison with other data, it is found that the apparent lifetimes of all the particles are about 1×10^{-8} sec. A.

539.18

2440. MASS-RATIO METHOD APPLIED TO THE MEASUREMENT OF L-MESON MASSES AND THE ENERGY BALANCE IN PION DECAY. W.H.Barkas, W.Birnbaum and F.M.Smith.
Phys. Rev., Vol. 101, No. 2, 778-95 (Jan. 15, 1956).

Reports a comprehensive series of measurements made on the masses of L-mesons produced by the 184 in. cyclotron. A general ratio principle of measurement is employed which largely eliminates systematic errors. The particular method developed is described in detail. The theory of nonequilibrium particle orbits in the cyclotron field is worked out to provide formulae from which momenta may be calculated, and to obtain the momentum distribution functions determined by the target and detector dimensions. The energy-loss processes in nuclear track emulsion, which is used as a stopping material and detector, are studied and the range-momentum exponent q is found. Several small corrections to the mean range are made. A number of range straggling effects are evaluated. The theoretical distribution of the quantity Rp^{-q} (R being the range and p the momentum) is studied, and the first three moments of the distribution are calculated explicitly. The distribution is found to be closely Gaussian. From the theory of the distribution of Rp^{-q}, the best estimate and the statistical uncertainty of the mass ratio (e.g., of meson to proton) are evaluated. A number of effects influencing the ratio are studied, but all the corrections found are very small. The measurement of the momentum acquired by the muon when a pion decays has also been treated. Several important relations connecting this quantity with the particle masses are then introduced. Apparatus developed for the application of the ratio principle is described. A number of experiments in which mesons and protons of similar velocities were detected in the same nuclear track plate are reported. Each experiment was repeated a number of times. The measurements of particle ranges and orbit parameters, the magnetic field measurements, the dimensional tolerances, the calculations, and other important details are discussed. The following mass ratios are reported: π^+/proton = $0.1488_7 \pm 0.000\,11$, $\pi^-/\pi^+ = 0.998 \pm 0.002$, $\pi^+/\mu^+ = 1.321 \pm 0.002$. The centre-of-mass momentum acquired by the muon in positive pion decay was measured as 29.80 ± 0.04 MeV/c and its energy, 4.12 ± 0.02 MeV. All the results are consistent if the rest mass of the neutral particle in the pion decay is zero. With this assumption, the measurements further imply that the positive pion-muon mass difference is 66.41 ± 0.07 electron masses. The derived masses, in units of the electron mass, are: $\pi^+ = 273.3 \pm 0.2$, $\pi^- = 272.8 \pm 0.3$, $\mu^+ = 206.9 \pm 0.2$. A.

539.18

2441. NUCLEAR SCATTERING OF SLIGHTLY RELATIVISTIC MUONS. H.Marschall and G.Meyer.
Z. Phys., Vol. 143, No. 1, 17-30 (1955). In German.

The scattering of μ-mesons of energy of about 30 MeV off mercury is studied. A uniform charge distribution for the nucleus is assumed. Phase shifts are obtained by the WKB method. G.E.Brown

539.18

2442. THE SCATTERING OF μ-MESONS IN LEAD AND IRON. J.L.Lloyd and A.W.Wolfendale.
Proc. Phys. Soc. A, Vol. 68, Pt 11, 1045-65 (Nov., 1955).

A description is given of a cloud-chamber experiment in which is investigated the dependence of the multiple and large-angle scattering of μ-mesons on momentum, sign and atomic number. The results are compared with Molière's theory for a point nucleus, Olbert's theory for an extended nucleus, and a more accurate modification of Olbert's theory. These theories give an adequate description of the multiple scattering for small momentum transfers. For large momentum transfers, where the size and structure of the nucleus should profoundly modify the scattering, Molière's theory is found to give a better description than Olbert's theory. A.

539.18

2443. PION-PROTON SCATTERING AT 150 and 170 MeV. J.Ashkin, J.P.Blaser, F.Feiner and M.O.Stern.
Phys. Rev., Vol. 101, No. 3, 1149-58 (Feb. 1, 1956).

The pion-proton differential scattering cross-sections have been measured at 150 and 170 MeV. Measurements were made at eight angles using scintillation counters and a liquid hydrogen target. Statistical errors are of the order 5% or less. Phase-shift analyses of the data have been made on the assumption that the isotopic spin is conserved and that only s and p waves are appreciably scattered. The angular distributions give no positive indication of any d-wave scattering. A.

539.18

2444. REACTION $^- + d \rightarrow 2n + {}^0$; PARITY OF THE NEUTRAL MESON. W.Chinowsky and J.Steinberger.
Phys. Rev., Vol. 100, No. 5, 1476-9 (Dec. 1, 1955).

The branching ratio between the capture reactions $\pi^- + d \rightarrow 2n + \pi^0$ and $\pi^- + d \rightarrow 2n + \gamma$ was determined to be less than 0.1%. Comparison with the previously measured branching ratio between the corresponding processes in hydrogen provides strong evidence for pseudoscalar π^0 parity. A.

539.18

2445. THE ENERGY DEPENDENCE OF THE SPECIFIC IONIZATION OF RELATIVISTIC μ-MESONS. J.Buschmann.
Z. Naturforsch., Vol. 10a, No. 9-10, 680-7 (1955). In German.

The rise in the specific ionization of very fast μ-mesons has been determined as a function of energy by selecting μ-mesons of given energy range from cosmic-ray showers, using G.M. counter telescopes; the ion-pairs created in an argon-filled proportional counter producing the ionization. Good agreement was obtained with the Bethe—Bloch theory, the logarithmic rise in ionization between 1 and 10 BeV being about 24%. D.J.Prowse

539.18

2446. ELECTRONS FROM MUON CAPTURE. J.Steinberger and H.B.Wolfe.
Phys. Rev., Vol. 100, No. 5, 1490-3 (Dec. 1, 1955).

A search was made for the process $\mu^- + p \rightarrow p + e^-$ or $^- + n \rightarrow n + e^-$ for μ-mesons stopped in a Cu target. Scintillation counters were employed to detect the electrons from the process. No counts attributable to the electrons were obtained and an upper limit of $\sim 5 \times 10^{-4}$ is given for the relative rate of this process to that for the usual nuclear capture reaction. A.

539.18

2447. ON THE ASSOCIATED PRODUCTION OF A MESON-ACTIVE $^4H_1$ FRAGMENT AND A K-MESON IN A NUCLEAR DISINTEGRATION. M.W.Friedlander, D.Keefe and M.G.K.Menon.
Nuovo Cimento (Ser. 10), Vol. 2, No. 3, 663-5 (Sept., 1955).

An event which can be interpreted as the mesonic decay of an excited H_1^4 fragment has been found. The fragment emerges from a 22 + 3p star and after coming to rest decays into what is thought to be an α-particle of 2.55 MeV and a π-meson of 53.1 MeV. The Q-value computed from the π-meson range is 55 MeV; the tracks being co-linear, this is

the most accurate method of calculating the Q-value, as the α-particle range is very small and is subject to large percentage errors. The binding-energy of the Λ^0-particle in the H^{4*}_{Λ} nucleus is calculated to be 1.2 ± 1.0 MeV. One of the tracks from the parent star is a K-meson of 270 MeV, the mass, from scattering v. grain-density, being $960 \pm 90\ m_e$. The interpretation of the event is therefore in terms of the associated production of a K-meson and hyperon which emerges bound to a triton. D.J.Prowse

539.18

2448. PHASE-SPACE INTEGRALS FOR MULTIPARTICLE SYSTEMS. M.M.Block.
Phys. Rev., Vol. 101, No. 2, 796-9 (Jan. 15, 1956).

The total phase-space integrals, occurring in the Fermi statistical theory of meson production, for 2-, 3-, 4-, and 5-body final states are reduced to forms suitable for numerical evaluation by hand computation. In addition, the momentum spectrum of any one particle, as derived from the statistical factor, is evaluated. For the 3- and 4-body systems, the Q distribution for any two of the particles (effective mass minus the rest masses of the 2-particle subsystem) is derived. Numerical results are presented for nucleon–nucleon collisions at 0.8, 1.5, and 2.7 BeV bombarding kinetic energies. A.

539.18

2449. EVIDENCE FOR THE ELECTROMAGNETIC PRODUCTION OF μ MESONS. G.E.Masek and W.K.H.Panofsky.
Phys. Rev., Vol. 101, No. 3, 1094-109 (Feb. 1, 1956).

Direct electromagnetic production of pairs of μ-mesons has been investigated. The means of detection chosen consists of searching for the production of single negative μ-mesons peaked sharply in the forward direction. The target chosen was aluminium, bombarded by bremsstrahlung from 575 MeV electrons, and the angular range studied was between 10^0 and 30^0. The experimental value of the cross-section σ_{exp} was referred to a theoretical value σ_{theor} computed by modifying the conventional formula for the pair production of fermions by photons in a Coulomb field by the introduction of a finite nuclear size. Observations carried out to date give $\sigma_{exp}/\sigma_{theor} = 1.93 \pm 0.68$. The quoted standard error defines the statistical accuracy only and is a measure of the likelihood of existence of the process; in addition, the absolute cross-section is uncertain to within a factor of 1.5. A.

539.18 : 539.172.3

2450. PARTIAL WAVE ANALYSIS OF THE EXPERIMENTAL PHOTOMESON CROSS SECTIONS. K.M.Watson, J.C.Keck, A.V.Tollestrup and R.L.Walker.
Phys. Rev., Vol. 101, No. 3, 1159-72 (Feb. 1, 1956).

The experimental data concerning photopion production is studied for photon energies below 400 MeV. The data are analysed in terms of S- and P-waves of the final pion-nucleon system, and an indication is obtained of the importance of higher partial waves. The "(3, 3) state" matrix elements seem to be significantly larger than the other P-wave matrix elements at energies below 400 MeV, but not at higher energies. The energy dependence of the various partial waves can be understood on the basis of rather general arguments. In addition to the S-wave and "enhanced" P-wave matrix elements involving the (3, 3) state, first order correction terms from the other, nonenhanced P-waves are included in the theory. This provides a fairly satisfactory description, for energies below about 350 MeV, of the positive and neutral photopion cross-sections in hydrogen, and of the ratio of π^- to π^+ production from deuterium. A.

539.181

2451. FOCUSING ATOMIC BEAM APPARATUS. A.Lemonick, F.M.Pipkin and D.R.Hamilton.
Rev. sci. Instrum., Vol. 26, No. 12, 1112-19 (Dec., 1955).

The construction and design principles are reported. This apparatus, which is of the radio-frequency magnetic resonance type and which has been used to measure the spins and hyperfine splittings of four radioactive nuclides as reported elsewhere, utilizes the six-pole focusing magnet of Friedburg and Paul and of Korsunskii and Fogel but in a way which avoids velocity aberrations. From an analysis of the optimization of intensities in the conventional and the focusing types of atomic beam apparatus it is concluded that the latter has an advantage of a factor of roughly twenty-five. A.

539.181

2452. SCATTERING OF HIGH VELOCITY NEUTRAL PARTICLES. VI. KRYPTON-KRYPTON. I.Amdur and E.A.Mason.
J. chem. Phys., Vol. 23, No. 12, 2268-9 (Dec., 1955).

For Pt V, see Abstr. 4102 (1955). Total collision cross-sections have been measured for krypton atoms with energies between 700 and 2100 eV, scattered in room temperature krypton, to obtain potential energy information for the interaction of two krypton atoms. The potential function may be represented by $V(r) = 2.55 \times 10^{-10}/r^{8.42}$ ergs for r between 2.42 A and 3.14 A. The present potential appears to be consistent with potentials, valid at larger separation distances, which have been derived from measurements of gaseous compressibility, transport, and crystal properties, within the limits of uncertainty of these larger distances potentials. A.

539.185

2453. ANGULAR CORRELATION IN THE BETA DECAY OF THE NEUTRON. J.M.Robson.
Phys. Rev., Vol. 100, No. 3, 933-5 (Nov. 1, 1955).

The electron-neutrino angular correlation coefficient was determined by measuring the momentum spectrum of those electrons emitted in the restricted angular range of about $145\text{-}175^0$ from the proton recoil direction. A plan of the apparatus is given and a graph of the momentum spectrum obtained. A value of +0.089, with a standard deviation of ± 0.108, is deduced for the correlation coefficient, which is consistent with a beta-decay interaction of the form ST with $g_T^2/g_S^2 = 1.49\ (+1.44, -0.56)$. J.Hughes

539.185

2454. A GENERATOR FOR FAST NEUTRONS. A.C.van Dorsten.
Philips tech. Rev., Vol. 17, No. 4, 109-11 (Oct., 1955).

The generator produces neutrons by the d–d reaction. Deuterons are produced in a high-frequency ion source and are accelerated by means of a cascade generator. Special features of this generator are that it has three columns arranged around the accelerating tube, and selenium rectifiers are used instead of thermionic valves. The generator is very compact and is placed in a steel drum of nitrogen at 10 atm. to provide insulation. The accelerating voltage is variable between zero and 1 MV and the ion current between zero and 1200 μ A. The beam strikes a thin target of D_2O ice which is maintained below -100^0 C by cooling with liquid nitrogen and by rotation of the target and lateral oscillation of the beam. A continuous emission of 10^{10} neutrons per second may be obtained. L.R.Shepherd

539.185

2455. THE SCATTERING OF HIGH ENERGY NEUTRONS BY A COULOMB FIELD. R.G.P.Voss and R.Wilson.
Phil. Mag. (Ser. 8), Vol. 1, 175-85 (Feb., 1956).

A polarized beam of 100 MeV neutrons is obtained from the A.E.R.E. cyclotron; this is scattered from uranium at angles sufficiently small for there to be an appreciable scattering from the interaction of the magnetic moment of the neutron with the Coulomb field. The scattering and polarization of the Coulomb field scattering are in agreement with theory, and enable a value for the sign and magnitude of the polarization of the neutron beam to be obtained. A.

539.185

2456. OPTICAL MODEL ANALYSIS OF SCATTERING OF 14-MeV NEUTRONS. G.Culler, S.Fernbach and N.Sherman.
Phys. Rev., Vol. 101, No. 3, 1047-52 (Feb. 1, 1956).

Preliminary results for the scattering of 14 MeV neutrons using exact phase-shift calculations are presented. The model used consists of step-well potentials both with and without spin-orbit interactions. A.

539.185.08 : 537.542

HELIUM-3 FILLED PROPORTIONAL COUNTER FOR NEUTRON SPECTROSCOPY. See Abstr. 1317.

STRUCTURE OF SOLIDS 539.2

539.211

2457. FRACTURE OF GLASS BY SPHERICAL INDENTERS. J.P.A.Tillett.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 47-54 (Jan., 1956).

The production of ring cracks in silicate glass, by the impact of steel balls and by the application of a static load to spherical indenters, has been studied for a large range of indenter curvature. It has been found that in impact tests a greater height of fall is required to produce ring cracks than predicted by a critical stress criterion of fracture. In static experiments, two different relations between the force required to produce fracture and indenter size have been found. Below a radius of curvature of approximately 3.5 cm the force is proportional to the radius and above this value to the square of the radius. Impact tests have also been carried out on a specimen of an organic glass-like material, with results similar to those of the impact experiments on silicate glass. A.

539.211

2458. INDENTATION HARDNESS OF GLASS AS AN ENERGY SCALING LAW. F.C.Roesler.
Proc. Phys. Soc. B, Vol. 68, Pt 1, 55-60 (Jan., 1956).

A number of independently found empirical laws for the occurrence of Hertzian ring cracks are all equivalent and can be put in the form of an energy scaling law. It is suggested that this is the true explanation of the observed size effects, which would then lie in the dynamical similarity relations of geometrically similar stress fields and fracture surfaces. A.

539.211

2459. THE DUCTILE FRACTURE OF POLYCRYSTALLINE α-IRON. N.J.Petch.
Phil. Mag. (Ser. 8), Vol. 1, 186-90 (Feb., 1956).

Evidence that ductile fracture requires a compressive stress on the dislocation arrays close in value to that required for cleavage is presented. It is shown that the ductile fracture stress σ_f is related to the grain diameter l by the equation $\sigma_f = \sigma_0 + kl^{-1/2}$, where σ_0 and k are constants. This is the same form of relationship as already found for cleavage and the slope k is practically the same for both types of fracture. A.

539.211 : 535.417

METHOD OF MEASURING ROUGHNESS. See Abstr.1133.

539.211 : 535.417

MECHANISM OF POLISHING GLASS. See Abstr. 1134.

539.213

2460. THE ROLE OF VISCOSITY IN THE FORMATION OF THE GLASSY STATE. A.Winter.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1281-4 (Nov. 7, 1955). In French.

A re-discovery of the fact that at the "softening" or "transformation" temperature of glasses the viscosity is of order 10^{13} poise. R.O.Davies

539.213

2461. RADIATION-INDUCED AMORPHISM IN DIAMOND. P.W.Levy and O.F.Kammerer.
Phys. Rev., Vol. 100, No. 6, 1787-8 (Dec. 15, 1955).

An annealed sample was irradiated in a reactor and X-ray diffraction patterns show that the specimen was thereby made amorphous. E.P.Wohlfarth

539.217

2462. THE THEORY OF THE DIFFUSION OF ATOMS IN ALLOYS. M.A.Krivoglaz and A.A.Smirnov.
Uspekhi fiz. Nauk, Vol. 55, No. 3, 391-442 (1955). In Russian.

A monograph by two of the leading Soviet workers in this field. The first part of the paper covers diffusion of atoms embedded in the interstices of a crystalline lattice and is illustrated by effects in alloys of the type β- brass and Fe_3Al. The second and more important section deals with diffusion when there is a Frenkel hole mechanism, in particular for body-centred and face-centred cubic lattices. Useful list of nearly 30 Russian refs. C.R.S.Manders

539.217

2463. THE OPTICAL INVESTIGATION OF DIFFUSION OF METALS INTO ONE ANOTHER. H.Schopper.
Z. Phys., Vol. 143, No. 1, 93-117 (1955). In German.

The thickness of a thin film of metal may be determined from the absolute phase change of light on reflection. Using this method, the changes in thickness of a composite film of two metals evaporated on to a glass substrate can be followed, and the course of the diffusion followed. The method has been applied to the interdiffusion of Au and Pb between 18^0 C and 100^0 C, and gives the result $D = 0.016 \exp -E/RT$ with E = 17 kcal. W.M.Lomer

539.219

2464. THE LATTICE SPACINGS OF SOLID SOLUTIONS OF TITANIUM, VANADIUM, CHROMIUM, MANGANESE, COBALT and NICKEL IN α -IRON. A.L.Sutton and W.Hume-Rothery.
Phil. Mag., Vol. 46, 1295-309 (Dec., 1955).

Accurate measurements have been made of the lattice spacings of dilute solid solutions of titanium, vanadium, chromium, manganese, cobalt and nickel in α-iron. In all cases the formation of the solid solution results in an expansion of the iron lattice, and for equal atomic percentages of the solutes, the expansions are in the order $Ti > V > Cr$ and $Co \leq Ni \leq Cu$. Manganese behaves anomalously, its effect being nearly the same as that of chromium. With titanium and vanadium as solutes there are negative deviations from Vegard's law, whilst for the remaining solutes the deviations are positive. These results, together with previous work on nickel alloys, are discussed, and some of the effects are ascribed to exchange repulsion between nearly filled d shells. A.

539.231

2465. THE DEPOSITION OF THIN FILMS OF GOLD ON CYLINDRICAL SPECIMENS BY SPUTTERING. F.R.Lipsett.
Brit. J. appl. Phys., Vol. 6, No. 12, 442-4 (Dec., 1955).

Apparatus and procedure are described for the deposition of very uniform thin films of gold on cadmium wires of 1 mm diameter. The effect of the geometry of the sputtering chamber is examined. Over-heating of the specimen is obviated by a simple device. A.

539.26

2466. ELECTRON MICROSCOPIC OBSERVATION OF MONOLAYERS OF SYNTHETIC LINEAR POLYMERS. T.Tachibana, K.Inokuchi and T.Inokuchi.

Nature (London), Vol. 176, 1117-19 (Dec. 10, 1955).

Crystalline polymer films when compressed on a water surface form microfibrils which are oriented at right angles to the direction of compression. Lowering the molecular weight of the polymer produces thicker microfibrils. Amorphous polymers do not show these effects. R.Reed

539.26 : 548.73

2467. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON THE STRUCTURES AND TEXTURES OF METALS — LONDON, OCTOBER, 1954. K.Robinson and E.G.Steward.
Brit. J. appl. Phys., Vol. 6, No. 11, 377-84 (Nov., 1955).

The annual Autumn Conference of the X-ray Analysis Group of The Institute of Physics was held in the Royal Institution, London, on 22 and 23 October, 1954. The first day's discussion centred on the structure of metals and alloys, whilst on the second day their texture was discussed. An evening lecture on dislocations was given by A.H.Cottrell. 82 refs. A.

539.27

2468. THE APPLICATION OF CATHODE SPUTTERING IN ELECTRON DIFFRACTION INVESTIGATIONS. O.Haase.
Z. Phys., Vol. 143, No. 2, 141-6 (1955). In German.

An attachment has been constructed for an electron diffraction apparatus by which thin layers can be sputtered from the surface of metal specimens in situ, immediately prior to examination in the electron beam. The apparatus differs from the usual cathode sputtering system in having a separate ion source in which ions are accelerated to the desired voltage, and in using the Penning discharge (in longitudinal magnetic field). In this way the main parameters (current, voltage and pressure) are brought under full control, the discharge is localized and a very low pressure can be maintained. The method has been employed on copper and iron single crystals. V.E.Cosslett

539.27

2469. THE STRUCTURE OF COLD WORKED GOLD. I. A STUDY BY ELECTRON DIFFRACTION. P.B.Hirsch, A.Kelly and J.W.Menter.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1132-45 (Dec., 1955).

The shape, number and arrangement of spots are studied on electron diffraction photographs of beaten gold foil. Various disturbing effects, including preferred orientation and refraction, on the deduction of particle size by spot counts are considered. After allowance for these a particle size of 1500 A ± 50% is obtained. Streaks and displaced spots are explained in terms of crystals with lamellar shapes and stacking faults on (111) planes. Heavily faulted lamellae of thickness less than 150 A and lamellar regions of hexagonal close packed gold are both found to exist. A.

539.27

2470. A SIMPLE ADAPTATION OF THE CARBON REPLICA TECHNIQUE FOR THE EXAMINATION OF SELECTED AREAS IN THE ELECTRON MICROSCOPE. D.E.Bradley.
Brit. J. appl. Phys., Vol. 6, No. 12, 430-2 (Dec., 1955).

The value of electron microscope replica techniques, particularly in metallurgical applications is greatly enhanced if it is possible to examine areas or features selected in the optical microscope. Though existing methods can be used to achieve this with the carbon replica, it has been found that they are not entirely suitable. The paper describes a simple and quick method for use with carbon replicas. To illustrate a possible field of application, a selected area of a pearlitic steel specimen is examined at different stages during etching treatment. A.

539.27

2471. A STUDY OF THE FORMVAR REPLICA PROCESS. A.W.Agar and R.S.M.Revell.
Brit. J. appl. Phys., Vol. 7, No. 1, 17-25 (Jan., 1956).

A detailed study has been made of Formvar replicas of various depths of structure. Plain replicas, shadowed repli and replicas shadowed on the back surface were prepared fr each specimen and identical areas were photographed in the electron microscope. An interferometer microscope was used to measure the depths of structure on the metal specim and on the back surfaces of the replicas. A reconstruction h thus been obtained of the shape of the replica cross-section under various conditions. As a result of this work, it is cor cluded that an approximately true negative replica of the sur face is only formed in the rare cases when the thickness of t film is more than double the depth of the structure. In spite of this, however, the Formvar replica is suitable for many classes of work and precautions can be taken to offset its deficiencies. An explanation is given for the varied publishe estimates of plastic replica resolution, and the resolution under standard conditions is estimated. A

539.2

2472. USE OF GOLD SOLS AS AN AID TO FOCUSING IN HIGH-RESOLUTION ELECTRON MICROSCOPY. T.H.Flewe and P.Tymms.
Nature (London), Vol. 177, 98 (Jan. 14, 1956).

The small dense particles produced by the citrate reduction of chlorauric acid are useful in focusing specimens of low contrast. R.Ree

539.2

2473. A MODIFIED REPLICA TECHNIQUE AND ITS APPLICATION TO THE EXAMINATION OF ETCHED SINGLE CRYSTALS OF BARIUM TITANATE. D.S.Campbell and D.J.Stirland.
Brit. J. appl. Phys., Vol. 7, No. 2, 62-5 (Feb., 1956).

A replica technique, combining the pre-shadowing and extraction methods, has been developed and applied to the stu of etched surfaces of barium titanate single crystals. The results obtained are discussed in relationship to the structure of barium titanate. A

539.27

2474. A COMPARISON OF DRY STRIPPED, UNBACKED COLLODION AND FORMVAR REPLICAS. D.J.Evans.
Brit. J. appl. Phys., Vol. 7, No. 2, 66-7 (Feb., 1956).

Dry stripped and unbacked Formvar and collodion replica from identical areas of metallic specimens are compared, an differences other than comparative stability in the electron beam are apparent. The ease and rapidity of preparation of the collodion and also its increased resolution over Formvar commends its use for routine metallographic examinations. A.

539.27

2475. COLLODION REPLICAS FROM CROSS-SECTIONS OF THIN METALLIC STRIP AND COATINGS. D.J.Evans.
Brit. J. appl. Phys., Vol. 7, No. 2, 65-6 (Feb., 1956).

The use of collodion as a replica material for obtaining electron micrographs of cross-sections of thin metallic strip and coatings is outlined. A.

539.27

2476. ELECTRON DIFFRACTION AND MICROSCOPE STUDY OF THE SURFACE STRUCTURE OF COPPER SINGLE CRYSTALS. S.Yoshida.
J. Phys. Soc. Japan, Vol. 11, No. 2, 129-37 (Feb., 1956).

The submicroscopic structure of electrolytically polished and etched surfaces of copper single crystals was studied by means of electron diffraction and electron microscope, supplemented by the method of light figures. The results indicate that the etched surfaces are composed of submicroscopic facets which belong to (100) zone and the electropolished surfaces are smooth and undulating. Assuming a simple model for the undulation, the mean inner potential of copper crystal was determined. The means value of the mean inner potential turned out to be 11 volts. A

539.27 : 536.424.1

2477. FIELD EMISSION MICROSCOPY OF AN ALLOTROPIC TRANSFORMATION: α - β TITANIUM. E.G.Brock.
Phys. Rev., Vol. 100, No. 6, 1619-26 (Dec. 15, 1955).

The field emission microscope has been applied to a study of the allotropic transformation in single microcrystals of titanium. Patterns with symmetry characteristic of the high and low temperature phases are presented. Techniques for analysing the patterns are outlined. Data derived from the pattern analyses give an orientation relation between patterns of the two phases that is consistent with the Burgers relation. The field emission microscope thus constitutes a new method for direct observation of phase changes. At the same time, it offers to the study of allotropic transformations the advantages of high resolution and great magnification that are not available with conventional methods. A.

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.31 : 539.185.9

2478. INTERPRETATION OF THE STORED ENERGY OF IRRADIATED GRAPHITE IN TERMS OF ELASTIC ENERGY ASSOCIATED WITH MICROSCOPIC STRAINS. A.E.Austin and R.J.Harrison.

An analysis of the (110) X-ray line shape is carried out assuming that the effects are due to strains rather than to particle size. The mean square strain is used to calculate the elastic energy stored, and is evaluated after various annealing treatments. It is found that this stored energy, after pile irradiation to a dose of 5×10^{19} n.v.t., is about 100 cal/cm^3, the majority of which anneals out below 200° C. Direct measurements of stored energy agree roughly with these results. W.M.Lomer

539.319 : 539.374 : 535.55

2479. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON STRESS ANALYSIS — SHEFFIELD, SEPTEMBER, 1955. H.Spooner.
Brit. J. appl. Phys., Vol. 7, No. 1, 1-9 (Jan., 1956).

The Ninth Annual Conference of the Stress Analysis Group of The Institute of Physics was held in the Stephenson Hall of the University of Sheffield on 28-30 September, 1955. Papers dealing amongst other things with design, plastic yielding, work at T.N.O. Delft, aircraft engine vibration, and photo-elastic investigations, were read, and are summarized in this report. A.

539.374

2480. ON VISCOELASTIC BODIES BEHAVING LINEARLY. J.Mandel.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1910-12 (Dec. 19, 1955). In French.

In an extension of the theory of elasticity to viscoelastic bodies, retaining the principle of superposition, a modulus is replaced by a relaxation function (of time), and a reciprocal modulus by a flow function. The functions are related through their Carson (or Laplace) Transforms. J.G.Oldroyd

539.382 : 534.39

2481. TENSILE DEFORMATION OF ZINC CRYSTALS AND EFFECT OF ULTRASOUND. F.Blaha and B.Langenecker.
Naturwissenschaften, Vol. 42, No. 20, 556 (1955). In German.

A short preliminary note describing the form of the stress—strain curves for Zn single crystals when extended up to about 3% with and without ultrasonic excitation. The initial stress required to produce a given strain was less when the specimen was excited; if, however, the specimen was stretched, without excitation, the stress decreased for a given extension merely by ultrasonic excitation. By alternately stretching the specimen and applying excitation, increasing amounts of strain could be obtained for a particular value of stress. H.J.H.Starks

539.384

2482. EXPERIMENTAL STUDY OF THE BENDING OF A CIRCULAR PLATE SUBJECTED TO A UNIFORM PRESSURE. J.Rabinovitch and A.Combettes.
Cahiers de Phys., No. 61, 35-40 (Sept., 1955). In French.

The normal displacement in the centre of a uniform disk of metal, glass, or plastic is measured optically, by observation of Newton's rings, as a function of applied pressure in two experiments: one with the edge of the plate simply supported, the other with the edge clamped. The results indicate the effectiveness of different methods of clamping, and in favourable circumstances independent measures of Young's modulus and Poisson's ratio can be deduced. J.G.Oldroyd

539.431

2483. THE ORIGIN OF FATIGUE FRACTURE IN COPPER. N.Thompson, N.Wadsworth and N.Louat.
Phil. Mag. (Ser. 8), Vol. 1, 113-26 (Feb., 1956).

Describes metallographic observations of the development of fatigue cracks in copper. The specimens (polycrystal and single crystals) were tested in push-pull at 1000 c/s. It was shown that the fatigue crack started in a slip band inside a single grain. An electropolishing technique showed changes in the character of the slip band after 5% of the life had expired. Cracks more than one grain long were present when half the life had expired. It was confirmed that the fatigue life could be increased by preventing access of oxygen to the surface. The bearing of these observations on the problem of the origin of a fatigue crack is discussed. A.

539.501

2484. ON THE FLOW OF MAXWELLIAN BODIES. J.Mandel.
C.R. Acad. Sci. (Paris), Vol. 241, No. 22, 1550-2 (Nov. 28, 1955). In French.

Examines the flow of a visco-elastic substance and makes an application to the case of large areas as for example of snow or clay soils. W.Bardsley

539.62 : 539.434

2485. CREEP AND STATIC FRICTION. R.T.Spurr.
Brit. J. appl. Phys., Vol. 6, No. 11, 402-3 (Nov., 1955).

It is shown that the static friction between a soft metal hemisphere and a flat surface increases with the length of time the surfaces have been in contact and that this increase is due to creep. Such creep might account for the difference between static and dynamic coefficients of friction. A.

539.67

2486. PRECISE INVESTIGATION OF THE THEORY OF DAMPING BY TRANSVERSE THERMAL CURRENTS. B.S.Berry.
J. appl. Phys., Vol. 26, No. 10, 1221-5 (Oct., 1955).

The frequency-dependence of internal friction of four α-brass (62.5% Cu) reeds was measured at room temperature under conditions where contributions to the internal friction other than that arising from transverse thermal currents were small and assessable. Measurements were made by the free-decay method, at maximum strain amplitudes of 5×10^{-6}. By using specimens of two different thicknesses, frequencies differing from the frequency of peak damping by nearly a factor of 20 were obtained by measurements in the range 7-370 c/s. The results, in conjunction with measurements of Young's modulus (1.06×10^{12} dynes/cm^2 ± 0.5%), coefficient of linear expansion (18.7×10^{-6}/deg C ± 0.5%), density (8.42 g/cm^3 ± 0.2%), specific heat (0.088 cal/g/deg C ± 2%), and thermal diffusivity (0.34 cm^2/sec ± 5%), indicate that Zener's theory of damping by transverse thermal currents is probably valid exactly. From the position of the peak, the thermal diffusivity is found more precisely as 0.346 cm^2/sec ± 1.5%. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.12

2487. ON THE INHIBITION OF THE NO - N_2O_5 REACTION BY NO_2. I.C.Hisatsune, A.P.McHale, R.E.Nightingale, D.L.Rotenberg and B.Crawford, Jr.
J. chem. Phys., Vol. 23, No. 12, 2467 (Dec., 1955).

On the basis of the mechanism:

$$N_2O_5 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} NO_2 + NO_3; \quad NO + NO_3 \xrightarrow{k_6} 2NO_2$$

a quantiative estimate of the ratio k_2/k_6 is obtained from the results of experiments with a fast-scanning infrared spectrometer. The Arrhenius activation energy associated with this ratio was 2 kcal per mole at both 400 and 57 mm total pressure.
W.Good

541.124

2488. OH, HO_2, AND H_2O_2 PRODUCTION IN THE REACTION OF ATOMIC HYDROGEN WITH MOLECULAR OXYGEN. S.N.Foner and R.I.Hudson.
J. chem. Phys., Vol. 23, No. 10, 1974-5 (Oct., 1955).

The components in the room-temperature low-pressure reaction of atomic hydrogen with oxygen have been identified by mass spectrometric methods. At room temperature they were H_2O and OH, the latter to the extent of about 1% of the O_2 concentration. Cooling the reactor (a diagram of this is given) to liquid N temperatures causes the OH intensity to drop to zero. On warming up, the (integrated) production of H_2O_2 was obtained. If HO_2 radicals are present in the glassy deposit (Abstr. 850/1954, 2978/1955), the experiments indicate that they must be formed on the surface. W.Good

541.124

2489. DISPLACEMENT OF THE MAXIMUM IN THE CONCENTRATION-TIME DIAGRAM OF TWO FIRST-ORDER CONSECUTIVE REACTIONS M.Talât-Erben.
J. chem. Phys., Vol. 23, No. 12, 2445-6 (Dec., 1955).

A theoretical interpretation is given of (1) the independence on temperature of the ratio of the maximum concentration of intermediate to the initial concentration of mother substance and (2) the proportionality of the time required to reach the maximum concentration of intermediate to the mean life of mother molecules. W.Good

541.124 : 539.132

2490. PYROLYSIS OF ACETONE AND THE HEAT OF FORMATION OF ACETYL RADICALS. M.Szwarc and J.W.Taylor.
J. chem. Phys., Vol. 23, No. 12, 2310-14 (Dec., 1955).

Pyrolysis of acetone in the presence of an excess of toluene has been studied. The rate of the decomposition has been followed by the rate of formation of CO, the following sequence of reactions being assumed: $CH_3.CO.CH_3 \rightarrow CH_3 + CO.CH_3$ (slow); $CH_3.CO \rightarrow CH_3 + CO$ (fast). The reactions seem to be first-order and unimolecular, the rate constant of the first step being determined as $k = 2.4 \times 10^{14} \exp(-72\,000/RT)\ sec^{-1}$. It is assumed that the observed activation energy may be identified with $CH_3.CO - CH_3$ bond dissociation energy and on this basis the heat of formation of acetyl radical is calculated at −10.8 kcal/mole. The last result is compared with the findings resulting from investigation of the pyrolyses of diacetyl and of benzyl methyl ketone. The validity of the toluene carrier technique is reviewed. A.

541.126

2491. SOME OBSERVATIONS RELATING TO DETONATIONS OF CARBON MONOXIDE–OXYGEN MIXTURES. H.G.Wagner.
Z. Elektrochem., Vol. 59, No. 10, 906-9 (1955). In German.

Researches relating to the determination of the depth of the reaction-zone in carbon monoxide–oxygen detonations, and the nature of the detonation process in the region of the walls of the detonation vessel, are reported and discussed. Photographs of reflected detonations and shock waves show that in the case of stable detonations, the reaction begins practically immediately behind the shock front. In gas mixtures having compositions approximating to the detonation limits, shock wave and reaction are separated from one anoth the processes are unstable but can, however, be propagated over long distances. J.S.G.Thomas

541.126

2492. THE INITIATION OF SPHERICAL DETONATION WAVES IN GAS MIXTURES. H.Freiwald and H.Ude.
Z. Elektrochem., Vol. 59, No. 10, 910-13 (1955). In Germa

Contrary to previous conception, that a detonation wave i extinguished on transition from a narrower to a wider tube, results obtained in the detonation of mixtures of oxygen and nitrogen with either acetylene or propane show that detonation of such mixtures, on reaching the tube end, spread out spheri cally into space; composition limits for this phenomenon to occur are given. Detonation waves in acetylene–oxygen–nitrogen mixtures of various compositions, initiated by an electric spark, were observed to pass from a process of combustion to a process of stable or unstable combustion.
J.S.G.Thomas

541.127

2493. POTENTIAL ENERGY SURFACE OF THE SYSTEM OF THREE ATOMS. S.Sato.
J. chem. Phys., Vol. 23, No. 12, 2465-6 (Dec., 1955).

See Abstr. 5687 (1955). Further examples illustrate the usefulness of the author's semiempirical method of calculatin the energy surface. For the H - H - Cl system the diagram does not show the basin appearing from Eyring's method. Again for the linear complex X_3, stable for the halogens according to Eyring's method, only a shallow basin is found and no saddle point, provided the parameter k is kept constant J.Jacobs

541.127

2494. VELOCITY–DIAMETER AND WAVE SHAPE MEASUREMENTS AND THE DETERMINATION OF REACTION RATES IN TNT. M.A.Cook, G.S.Horsley, W.S.Partridge and W.O.Ursenbach.
J. chem. Phys., Vol. 24, No. 1, 60-7 (Jan., 1956).

Velocity (D) v. diameter (d) curves for low density TNT o various grain sizes were obtained over a range of diameters from the minimum propagation or critical diameter d_c to abov the smallest diameter d_m^* required for detonation at the theoretical maximum velocity D^*. Also measurements of the shapes of the wave fronts were made at different diameters and particle sizes. The results were interpreted by means of the theories extant of the influence of reaction rates in detonation. The velocity–diameter curves were shown to have the shapes required by the "nozzle theory" but not those predicted by the "curved front" theory. The results were in accord with the Eyring surface burning theory in which the flame fron is postulated to penetrate the individual grains at a radially constant velocity. Critical diameters were found to occur at the diameters at which D/D^* was about 0.75. The steady-state wave fronts were found to be essentially spherical with a radius of curvature R_m varying from 0.7 d near the critical diameter to about 1.9 d at d = 20 cm for the coarsest product studied. Also R_m/d was found to increase with decreasing particle size at a given diameter in the $D/D^* < 1.0$ region and at a lower rate at and above d_m^*. A.

541.126

2495. MICROWAVE OBSERVATION OF DETONATION. J.L.Farrands and G.F.Cawsey.
Nature (London), Vol. 177, 34-5 (Jan. 7, 1956).

A technique is described for measuring the velocity of detonation of high explosives under contained conditions by means of the reflection of microwaves from a region travelling with the detonation front. The method employs the principles of microwave interferometry together with continuous recording of the intensity of the interference field at a point as the detonation moves along the containing tube. A.Gelbtuch

541.126

2496. MASS SPECTROMETRIC INVESTIGATION OF THE HYDROGEN-OXYGEN AND METHYL-OXYGEN REACTIONS. K.U.Ingold and W.A.Bryce.
J. chem. Phys., Vol. 24, No. 2, 360-4 (Feb., 1956).

The reactions of hydrogen and of methyl radicals with oxygen have been studied by means of a mass spectrometer designed to detect free radicals. The reactants were present at low pressures in a stream of helium. Radicals detected were OH and HO_2 in the hydrogen-oxygen reaction, and CH_3O, CH_3O_2, OH, HO_2, CH_2, and probably CHO in the methyl-oxygen reaction. A rough value of 10^{-3} to 10^{-4} was obtained for the collision efficiency of the oxygen + methyl radical reaction. A.

541.126 : 534.222.2

2497. ENHANCED INITIATING EFFECT OF MULTIPLE SHOCK INTERSECTIONS. C.H.Winning.
Nature (London), Vol. 177, 33-4 (Jan. 7, 1956).

Photographic evidence suggests that weak shock waves, which are unable singly to initiate underwater explosion, can do so when they meet and reinforce one another. A.Gelbtuch

541.127

2498. ENHANCED OXIDATION OF PLATINUM IN ACTIVATED OXYGEN. G.C.Fryburg.
J. chem. Phys., Vol. 24, No. 2, 175-80 (Feb., 1956).

An enhanced oxidation of platinum has been observed in moist activated oxygen, and the cause of this enhancement has been investigated. The surface oxidation was examined at 1000^0 C and 0.50 mm Hg pressure of oxygen, and the rate was found to be markedly increased by the oxygen atoms. The reaction was found to obey a linear law of the form $\omega = (k + k_2 n_0)t$, where n_0 is the number of oxygen atoms striking unit area of the platinum per second. Oxygen atoms were shown to be at least 400 times more reactive than oxygen molecules. A.

541.128

2499. HALOGEN CATALYZED DECOMPOSITION OF NITROUS OXIDE. F.Kaufman, N.J.Gerri and D.A.Pascale.
J. chem. Phys., Vol. 24, No. 1, 32-4 (Jan., 1956).

The thermal decomposition of N_2O in the presence of added Cl_2, Br_2, I_2 and C_2H_5I was studied over the temperature range 876 to 1031^0K. The catalytic reaction was found to be first order in N_2O and in atomic halogen concentration. The rate constants are in the order Cl > Br > I. Activation energies of 33.5, 37 and 38 kcal and pre-exponential factors of 1.3, 2.0 and 2.8×10^{14} cm^3 $mole^{-1}$ sec^{-1} were found for the Cl, Br and I reaction. A probable mechanism is discussed and qualitative evidence provided for a high rate constant for the dissociation of Cl_2, analogous to reported values for Br_2 and I_2. A.

541.128 : 537.311.33

ELECTRICAL CONDUCTIVITY OF HYDROCARBON CRACKING CATALYST. See Abstr. 1235.

ELECTROCHEMISTRY 541.13

541.132

2500. INVESTIGATIONS ON HYDROGEN OVERPOTENTIAL. G.Darmois-Sutra and E.Darmois.
Z. Elektrochem., Vol. 59, No. 7-8, 659-62 (1955). In French.

H^+ is construed as a proton endowed with thermal motion in a cage of H_2O molecules (see also Abstr. 2290/1947). By applying the Drude-Lorentz theory and the principles of classical statistics to this motion, the authors obtain explanation of: (1) the abnormally high conductivity of H^+, (2) the H^+/D^+ ionic mobility ratio and (3) the high heat of hydration of these ions. A theory of hydrogen overpotential is developed from the following model: H^+ with H_2O molecules are adsorbed by the cathode, the protons escaping from time to time and forming H atoms on the cathode. F.Lachman

541.132

2501. RESEARCHES ON THE OVERVOLTAGE OF HYDROGEN. G.Darmois-Sutra and E.Darmois.
Bull. Soc. Franç. Elect., Vol. 5 (Sér. 7), 673-7 (Oct., 1955). In French.

It is proposed that the hydrogen ion exists in aqueous solution not as $(H_3O)^+$ but as a proton associated with four water molecules. A review is given of previous work in which this concept has been used to explain many of the "anomalous" properties of the hydrogen ion. The concept is then applied to the problem of the overvoltage of hydrogen, using Slater's theory of unimolecular reactions. Reasonable agreement with experiment is obtained. C.E.King

541.132

2502. THE THEORY OF OVERVOLTAGE AND ITS APPLICATIONS. R.Audubert.
Bull. Soc. Franç. Elect., Vol. 5 (Sér. 7), 678 (Oct., 1955). In French.

By considering the processes of ionization and discharge of ions in terms of the energy changes involved an expression is derived relating current to ionic activity, activation energy, potential and ionic transference number. This was verified experimentally for several anions and cations. The theory is applied to the problem of the mechanism of the anodic solution of metals and to corrosion phenomena. Experimental verification was obtained in several instances. C.E.King

541.135

2503. ELECTROLYTIC HIGH-DEGREE PURIFICATION WITH LIQUID ELECTRODES. A.Gäumann.
Schweiz. Arch. angew. Wiss. Tech., Vol. 21, No. 10, 337-42 (Oct., 1955). In German.

The conditions of the aqueous-electrolyte—mercury system are investigated for the cathodic deposition of pure metals, and for the consequent anodic dissolution of the resulting amalgam prior to deposition on the inert cathode. Solubility limits and electrochemical conditions restrict the method, however, to the metals; Zn, Cd, Hg, In, Tl, Sn, Pb, Bi, Sb, Cu, Co and Mn. The highest degree of purity, 99.99995%, was obtained for In. By replacing mercury with another metal (e.g. Al, Sn, or Zn) or suitable alloy, the conditions are shown to be realizable for the deposition of any metal. The above restricted method is thus generalized. There are 11 diagrams. H.H.Hodgson

541.135 : 541.64

2504. CHAIN MODEL FOR POLYELECTROLYTES. III. EQUIMOLAR POLYAMPHOLYTES OF REGULARLY ALTERNATING STRUCTURE. S.A.Rice and F.E.Harris.
J. chem. Phys., Vol. 24, No. 2, 326-35 (Feb., 1956).

The model developed in Pt I and II (Abstr. 1324-5/1955) is extended to polyampholytes composed of a regular alternation

of acidic and basic groups. Included in this model are the effects of counter ion binding, dissociation equilibria among the acidic and basic groups, and electrostatic interactions among the charges of the polymer. The electrostatic free energy of interaction between neighbouring charges of the chain was computed including interactions between both nearest and next nearest neighbouring charge sites by a simple extension of the methods previously employed. The equilibrium conditions are then expressible as a set of simultaneous equations which may be solved by a convenient iterative method. The end to end extension may be calculated by previously described methods except in the vicinity of the isoelectric point (i.p.), near which point the effects of charge fluctuations become relatively more important. It is shown how both charge fluctuation and the distribution of monomer units along the polymer chain are related to its end to end extension. However, for a regularly alternating copolymer the skeletal distribution effect vanishes. Calculations for a hypothetical polymer indicate that the expansion is nearly independent of ionic strength, and that the fluctuations produce a negligibly small contraction of the i.p. However, it is found that added salt acts, primarily by reducing the electrostatic forces, to alter the titration curves in the same manner as has been observed experimentally in dilute protein solutions. A.

541.135 : 541.64

2505. CHAIN MODEL FOR POLYELECTROLYTES. IV. SKELETAL DISTRIBUTION EFFECTS IN EQUIMOLAR POLYAMPHOLYTES. F.E.Harris and S.A.Rice.
J. chem. Phys., Vol. 24, No. 2, 336-44 (Feb., 1956).

The model is extended to equimolar polyampholytes of general skeletal structure. The present development differs from that for copolymers consisting of a regular alternation of acidic and basic groups in that the environments of the individual groups will depend upon the local skeletal distribution. This inhomogeniety affects both the titration and configurational properties, primarily through a displacement of the acid-base equilibria. In addition, locally inhomogeneous skeletal structure can cause either an expansion or contraction at the isoelectric point, although strong deviation from random copolymerization is necessary to realize a large effect. No experimental data are available with which to compare the theory, but a calculated titration curve and expansion ratio are presented for a hypothetical polyampholyte of random skeletal structure. It is found that the titration curve of the random copolymer exhibits more buffer action near the isoelectric point than does a similar regularly alternating copolymer, but that the configurational properties and the effect on the titration curve of increased ionic strength are quite similar to the corresponding effect for the regularly alternating copolymer. It is pointed out that the substantial change in titration properties may be realized by alterations in the skeletal structure of a copolymer. A.

541.135.5 : 548.5

2506. ON THE ELECTROLYTIC FORMATION OF MERCURY NUCLEI ON SPHERICAL Pt SINGLE CRYSTAL ELECTRODES. R.Kaishev and B.Mutafchiev.
Izv. Bulg. Akad. Nauk , Vol. 4, 105-17 (1954; publ. 1955).
In Bulgarian, with summary (1 p.) in German.

An investigation of the dependence of nuclei formation on the properties of the substrate. A special impulse generator delivers a square wave voltage impulse of known height and duration to the cathode and the nuclei formed are counted. Tests with deposited Ag have shown that the activities in the neighbourhood of the various crystallographic poles of the Pt single crystal are different. Photographs illustrate the variation in the distribution of Hg nuclei for increasing values of the impulse voltage E, and the numbers of nuclei, N_{111} and N_{001}, which are deposited around the 111 and 001 poles respectively for the same E and duration of impulse are tabulated. The results agree with theory in that log N is linearly related to $1/\eta^2$, where η is the over-potential. S.Weintrou

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

2507. PHOTOSENSITIZED DECOMPOSITION OF ACETYL PEROXIDE. C.Luner and M.Szwarc.
J. chem. Phys., Vol. 23, No. 10, 1978-9 (Oct., 1955).

Radiation of wavelength 3650 A decomposes acetyl peroxi in iso-octane containing small amounts of anthracene (or naphthacene), the latter acting as sensitizers. It is found that the rate of decomposition becomes independent of the con centration of the anthracene if this is above 1×10^{-4}. The ratios of the CH_4 to CO_2 and C_2H_6 to CO_2 produced were observed in relation to anthracene and acetyl peroxide concentra tions and to light intensity. The results indicate that ethane is formed in a cage reaction. W.Good

541.14

2508. REVERSIBLE FLASH BLEACHING OF CHLOROPHYLL. E.W.Abrahamson and H.Linschitz.
J. chem. Phys., Vol. 23, No. 11, 2198-9 (Nov., 1955).

By means of a flash technique which is briefly described the existence in the metastable state is established of a far red absorption band previously observed in the steady-state bleaching studies. Photographs of oscilloscope traces are given in which reversible bleaching of chlorophyll-B at the main absorption peaks (6550 A and 4700 A) is evident. New absorption bands appear in the far red, in the green and in the violet. Similar experiments in chlorophyll-A show the same general features of the new absorption spectrum. Preliminary results of the flash bleaching of chlorophyll-B in wet and dry hydrocarbon solvents are given. W.Good

541.14

2509. PHOTOLYSIS OF ACETIC ANHYDRIDE. H.Burwasser and H.A.Taylor.
J. chem. Phys., Vol. 23, No. 12, 2295-9 (Dec., 1955).

The photolysis of acetic anhydride has been studied using a hot mercury arc at temperatures from 60° to 160° C by analysis of the gaseous products. CO and C_2H_6 are produced at equal rates which are one-half the rate of production of CO_2. At 60° C, CO production is delayed initially but in time reaches the same rate as C_2H_6. Using acetone as actinometer the quantum yield of CO_2 is two, of CO and C_2H_6, unity. The decomposition of acetic anhydride can be photosensitized by acetone. Mass-spectral analysis of the liquid residue at 160° showed the absence of acetone, biacetyl, methyl acetate, acetylacetone, and acetonyl acetone. A fragment of mass 57, increasing in intensity with duration of reaction was present in amounts sufficient to account for a material balance. Some steps in the mechanism are discussed. A.

541.15

2510. RADICAL YIELDS IN X-IRRADIATED AQUEOUS SOLUTIONS. J.H.Baxendale and D.Smithies.
Experientia, Vol. 11, No. 11, 436-7 (1955).

The value of $G_H + G_{OH}$ (G = yield per 100 eV absorbed) can be obtained by use of solutions of certain organic compounds together with Cu^{2+} and/or Fe^{3+} ions. The metal ions are reduced by H and by the radicals produced by oxidation of the organic substances by OH. At appropriate concentrations of the reactants it can be shown that $G_{Fe^{3+}} = G_H + G_{OH}$. C.B.Allsopp

541.15 : 539.132

2511. PHOTOCHEMICAL EVIDENCE RELATIVE TO THE EXCITED STATES OF OXYGEN. D.H.Volman.
J. chem. Phys., Vol. 24, No. 1, 122-4 (Jan., 1956).

Recent results on the formation of ozone from oxygen

photosensitized by mercury vapour at 2537 A show that the effects of foreign gases on deactivating the excited state of oxygen formed by energy transfer are He, A, N_2 and CO_2 in order of increasing efficiency. However the efficiencies of A and N_2 are about the same. Consideration of the process of deactivation by collision indicate that the $^3\Sigma_u^+$ state of O_2 is not the excited state involved, and that the excited state is vibrationally excited O_2 in the ground state, $^3\Sigma_g^-$. Analogous arguments applied to the unsensitized reactions at 1849 A, where the effects of the added gases are in opposite order, show that after the absorption of light predissociation occurs from the $^3\Sigma_u^-$ state of O_2. A.

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182.025

2512. YIELD STRESS OF CLAY—WATER SUSPENSIONS. A.Packter.
Nature (London), Vol. 177, 144-5 (Jan. 21, 1956).

The yield stress of some American, English and Mediterranean sodium and sodium—calcium montmorillonites and kaolinites under a variety of conditions was shown to depend on the particle—particle interaction as determined from the Schultz—Blatschke relation using a Stormer viscosimeter. J.E.Caffyn

541.183 : 533.7

NEW MODEL FOR 2-DIMENSIONAL STANDARD STATE.
See Abstr. 983.

CHEMICAL STRUCTURE 541.2/.6

541.28

2513. BOND RUPTURE AND NONRUPTURE IN THE BETA DECAY OF CARBON-14 STUDIED BY DOUBLE ISOTOPIC LABELING. R.L.Wolfgang, R.C.Anderson and R.W.Dodson.
J. chem. Phys., Vol. 24, No. 1, 16-23 (Jan., 1956).

The effect of beta decay of a constituent carbon atom of the ethane molecule has been studied by a technique of double labelling, with $C^{14}H_3C^{14}H_3$. The radioactivity of one of the carbon atoms served as a tracer for the entity which results from the decay of the other to nitrogen when the chemical bond is preserved. It was found that in 47% of the cases the molecular entity was not disrupted but survived as methyl amine, $C^{14}H_3NH_2$. This result is in good agreement with theoretical expectations. A.

541.28 : 539.132

2514. EXCITATION AND DISSOCIATION OF MOLECULES DUE TO β DECAY OF A CONSTITUENT ATOM. M.Wolfsberg.
J. chem. Phys., Vol. 24, No. 1, 24-32 (Jan., 1956).

The theory of electronic, vibrational, and rotational excitation of a molecule, specifically a diatomic molecule, due to beta decay of a substituent atom is presented. The nature of the vibrational and rotational excitation for certain specific cases is mathematically investigated. The problem of dissociation arising from the excitation of rotations is discussed. It is shown that it is very difficult to obtain exact figures on the probability of dissociation due to the excitation of vibrations and rotations. Molecular orbital wave functions are employed to gain some insight into the electronic excitation of the daughter molecule. A very rough calculation is made of the probability of nondissociation in the decay of C^{14} labelled ethane. A.

541.56

2515. ELECTRONEGATIVITIES OF THE ELEMENTS. W.Gordy and W.J.O.Thomas.
J. chem. Phys., Vol. 24, No. 2, 439-44 (Feb., 1956).

Electronegativity values derived from various methods are compared, and a complete electronegativity scale is arranged for all the elements. A chart is given which shows a systematic relation of electronegativity to the periodic system of the elements. A linear relationship is found between electronegativity and the work function of metals. A.

541.57

2516. THE THEORY OF CHEMICAL BOND. W.Heitler.
Ark. Fys., Vol. 10, Paper 13, 145-56 (1955).

This Fritz London memorial lecture was given in Stockholm in 1955. A qualitative survey of the theory of the covalent bond is made, based on the ideas of Heitler and London, that atomic interaction is a function of distance. Developments of the theory for valency, activation energy, directional properties, and binding energies are discussed. J.Jacobs

541.571

2517. "SMOOTHED POTENTIAL" THEORY OF CHEMICAL BINDING. J.R.Arnold.
J. chem. Phys., Vol. 24, No. 2, 181-4 (Feb., 1956).

A simple model, similar to the "free electron" theory of metals and conjugated systems, is shown to yield good values for the energies of most single covalent bonds. The model can be extended to multiple bonds and charged species, but not in its present form to excited states and unstable species. It can be correlated with the free electron theory of metals. The significance of the success of this and other simple models in predicting bond energies is discussed. A.

541.63 : 539.13

2518. STEREOCHEMICAL CONSEQUENCES OF INTRAMOLECULAR ATTRACTIVE FORCES. G.J.Szasz.
J. chem. Phys., Vol. 23, No. 12, 2449-50 (Dec., 1955).

The zero energy difference between trans and gauche rotational isomers in n-propyl chloride and bromide vapours may be explained if the electrostatic attraction between the halogen atoms and the methyl group becomes significant in the gauche configuration. This predicted increased stability is verified for some rotational isomers of isobutyl halides. J.Jacobs

541.634

2519. MECHANISM OF THE CONVERSION OF CIS- TO TRANS-MODIFICATIONS OF THE UNSATURATED HIGHER FATTY ACID ESTERS BY NITROGEN DIOXIDE. N.A.Khan.
J. chem. Phys., Vol. 23, No. 12, 2447-8 (Dec., 1955).

Results of infrared absorption analyses show that methyl oleate (1) does not react with N_2O to form either a trans-isomer (A) or a N derivative (B), (2) with NO it does not form (A) but does form a considerable proportion of (B), while (3) under the influence of NO_2 it produces c. 50% of (A) and considerable quantities of (B). The reaction of NO_2 with unsaturated compounds is strongly exothermic. Methyl linolenate showed, at first, no presence of (A) when treated with NO_2, but after 1 hour appreciable amounts of (A) were detected; they were destroyed by the application of a high vacuum. A mechanism of the cis/trans isomerism is proposed. F.Lachman

541.64 : 533.7

2520. MASS SPECTRA OF CuCl, CuBr, AND CuI. H.M.Rosenstock, J.R.Sites, J.R.Walton and R.Baldock.
J. chem. Phys., Vol. 23, No. 12, 2442 (Dec., 1955).

Results of mass-spectrometrical investigations indicate that the predominant vapour species in all three compounds is the trimer. In addition to considerable proportions of dimers and monomers, also a small quantity of tetramer has been found. When a CuBr sample was vaporized so as not to exclude the possibility of contamination with CuCl, mixed halide ions were detected. F.Lachman

541.651 : 541.67

2521. TEMPERATURE DEPENDENCE OF THE MAGNETIC AND OPTICAL PROPERTIES OF ORGANIC NITROGEN RADICALS. K.H.Hausser.
Z. Naturforsch., Vol. 11a, No. 1, 20-32 (1956). In German.

At low temperature the paramagnetic susceptibilities of N-ethyl-phenazyl, Wursters Blue-perchlorate, and various tetrazolium radicals are considerably smaller than would be expected from the Curie law and, in some cases, vanish. In the former two substances new long-wavelength absorption bands appear with decreasing temperature. The phenomena are considered to be due to a coupling of the π-electron systems of the plate-like molecules. It is concluded from the nature of the dependence on concentration and temperature of the long-wavelength absorption band that two phenylazyl molecules combine and the heat of dissociation of the combination is 2 kcal. per mole. W.Good

541.651.5

2522. ON CHROMIC ISOMERISM IN DIANTHRONE AND ITS ANALOGS. E.Harnik.
J. chem. Phys., Vol. 24, No. 2, 297-9 (Feb., 1956).

Two possible ways in which intramolecular overcrowding in dianthrone can be relieved are shown to lead to two stable, interconvertible molecular configurations, separated by a potential barrier. The two molecular configurations are briefly described. The height of the potential barrier is estimated, and found to agree well with that observed between the two isomers — referred to as chromic isomers — responsible for the thermo-chromic behaviour of dianthrone. It is therefore suggested that the two molecular configurations described are identical with the two chromic isomers, and that this model applies also to analogous compounds. Some observed phenomena are discussed in support of the proposed model. A.

CHEMICAL ANALYSIS 543/545

545.7 : 533.5

2523. THE ANALYSIS OF GASES AT LOW PRESSURES. M.A.Cayless.
Brit. J. appl. Phys., Vol. 7, No. 1, 13-16 (Jan., 1956).

An apparatus for handling and analysing small quantities of gas at low pressures is described. To avoid contamination an all-glass construction is employed and manipulation is entirely over mercury. Gases and gas mixtures may be readily introduced into experimental vacuum devices in measured quantities of 1 μcm^3 and over at pressures as low as 10^{-6} mm of mercury. Evolved gases may be analysed at pressures between 10^{-3} and 1 mm of mercury using mainly physical properties such as vapour pressure, diffusion and absorption for indentification and separation. Normally an accuracy of about 2% of the total quantity is obtained when 5 μl or more is available. A method is described of identifying much smaller quantities in certain circumstances. A.

545.8 : 535.372

2524. USE OF PHOSPHORESCENCE AT ORDINARY TEMPERATURES FOR CHEMICAL ANALYSIS. I. AMINO ACIDS. B.Rybak, R.Lochet and A.Rousset.
C.R. Acad. Sci. (Paris), Vol. 241, No. 19, 1278-80 (Nov. 7, 1955). In French.

Some photometer curves of phosphorescence spectra are given and it is claimed that the method is promising. J.Ewle

545.8 : 539.172

2525. ACTIVATION ANALYSIS OF ELEMENTS WITH A SHORT HALF-LIFE. P.Lévêque and H.Goenvec.
Bull. Soc. Chim. France, 1955, No. 10, 1213-16 (Oct.). In French.

The reaction $F^{19}(n,\gamma)F^{20}$ has a cross-section of 0.01 bar for thermal neutrons. F^{20} emits a beta particle of more tha 5.2 MeV and a gamma quantum of 2.2 MeV with a half-life of 12 seconds. It is possible to count the induced radioactivity of F^{20} even if the sample contains elements with a higher cross-section, such as Na, Ca, O and P, in excess, using a end-window counter with a filter of more than 500 mg/cm^2. It is necessary, however, to expose the sample to a high ne tron flux for a time close to 15 seconds, and count within the next 2 minutes. The method is calibrated by exposing samp of known F content. The values obtained spread ± 5% from t mean value for samples containing 1% - 3% F and low Na con tent. The spread increases with decreasing F content and increasing Na content. Analysis of trifluorochloropolyethyle was carried out by counting the 12 seconds activity of F and the 38 minute activity of Cl. The results obtained were with 1% of the values determined chemically. In mixtures of Hf and Zr it is possible to apply the same principle, using a sci tillation counter assembly. The induced 19 seconds activity of Hf can be measured with an accuracy similar to that reported for F. M.Ebe

545.82

2526. DETERMINATION OF SMALL QUANTITIES OF WATER IN FILMS AND ORGANIC LIQUIDS. K.Hoffmann and L.Fischer.
Chem.-Ingen.-Tech., Vol. 27, No. 10, 604-7 (Oct., 1955). In German.

Absorptiometric determination of water in the near infra red (1-2 micron) can be conducted by means of a relatively simple and versatile apparatus, because in this range the spectrum resolution can be effected with the use of interference filters, while PbS photoresistors can be used as detectors. In the apparatus used by the authors, a deflection equa to 1% of the scale was obtained for a 1 micron thick water layer or for a 2 m path in a fluid containing 1 g/m^3 of water vapour. F.Lachma

545.82

2527. X-RAY REFLECTION RADIOGRAPHY. W.Braun.
Z. angew. Phys., Vol. 7, No. 11, 527-32 (1955). In German

A discussion of the application of X-ray reflection radiography to the study of the distribution of heavy alloying elements in Al alloys. Regions as small as 10 μ can be resolve and it is concluded that when a photographic plate is used as the detector, the optimum X-ray wavelength is about 0.1 A. By the use of a scintillation counter as detector, the method can be used for the quantitative study of the concentration of alloying elements in different regions of an alloy. About 0.2% of Ca in Al can be detected in this way. A.E.De Bar

CRYSTALLOGRAPHY 548

548.5

2528. SPIRAL-TYPE GROWTH FRONTS IN THE ELECTROLYTIC CRYSTALLIZATION OF SILVER. R.Kaishev, E.Budevski and I.Malinovski.
Izv. Bulg. Akad. Nauk., Vol. 4, 93-104 (1954; publ. 1955). In Bulgarian, with summary (1 p.) in German.

Photographs of growth spirals on (100) and (110) planes are given. Using the theory of Frank (Abstr. 6560/1951 and 3098/1952) the approximate expression $\eta = 0.85/d$ for the over-potential η in mV in terms of the distance d in microns between the turns of the spiral is deduced. Observed values of d for spirals on the (100) surface together with their corresponding calculated overpotentials are tabulated. The values of η show that η is too small to be measured. S.Weintroub

548.5

2529. ON THE GROWTH FORMS OF CRYSTALS AND THE INFLUENCE OF ADSORPTION ON THE LINEAR SPEED OF CRYSTALLIZATION. G.Bliznakov.
Izv. Bulg. Akad. Nauk., Vol. 4, 135-52 (1954; publ. 1955). In Bulgarian with summary (2 pp.) in German.

The influence of adsorbed mixtures on the growth of crystal surfaces is discussed theoretically. Starting from the general relation $I = ke^{-(Q + \eta + A_2)/RT}$ for the speed of growth, where Q is the energy increase corresponding to the diffusion, η to the passage through the adsorbed film, and A_2 to the growth of the nuclei on the crystal surface respectively, two particular cases are considered. The first is where only A_2 and the influence of adsorption on it need be considered, and the second where the adsorption produces only η. The theoretical results are compared with the experimental values of W.A.Mokiewsky and I.A.Mokiewskaja, Zapiski Bsesoyuznogo Mineralogicheskogo Ovshchestva, Vol. 79, 15 (1950) on the influence of borax on the velocity of crystallization of $MgSO_4.7H_2O$. S.Weintroub

548.5

2530. THE INFLUENCE OF THE ABSORPTION OF FOREIGN SUBSTANCES ON CRYSTAL GROWTH.
G.Bliznakov and E.Kirkova.
Izv. Bulg. Akad. Nauk , Vol. 4, 153-66 (1954; publ. 1955). In Bulgarian, with summary (1 p.) in German.

Using a new type of circulation apparatus the influence of Na_2SO_4 on the speed of growth of the (111) and (100) faces of $NaClO_3$, and of methylene blue on the speed of growth of the (111) and (100) faces of lead nitrate crystals is investigated. The results, which are tabulated and shown graphically, are discussed in some detail. S.Weintroub

548.5

2531. SINGLE CRYSTALS OF THE OXIDES OF THE TRANSITION ELEMENTS BY THE FLAME FUSION METHOD.
E.J.Scott.
J. chem. Phys., Vol. 23, No. 12, 2459 (Dec., 1955).

Single crystals were grown in boules of about 8 mm dia and 2.5 cm long of the single oxides, binary systems of the divalent metal oxides, ferrites, and aluminates. W.Bardsley

548.5 : 539.23

2532. STUDY OF CUPROUS OXIDE FORMED AT 410°C AT PRESSURES OF AIR BETWEEN 0.5 AND 75 mm OF Hg.
K.R Dixit and V.V.Agashe.
Z. Naturforsch., Vol. 11a, No. 1, 41-5 (1956).

At these low pressures there is only one oxide, namely Cu_2O. The increase of pressure and the time of oxidation appear mainly to produce a change in the orientation of the Cu_2O crystallites. The films when sufficiently thick peal off, but even at this stage of thickness (1 μ to 3 μ) they do not show any electrical resistance or rectification. A.

548.52

2533. THE MUTUAL OVERGROWTH OF Cu AND Cu_2O AFTER OXIDATION AND REDUCTION. G.Jellinek, E.Menzel and C.Menzel-Kopp.
Z. Naturforsch., Vol. 10a, No. 9-10, 802-3 (1955). In German.

The Cu_2O layers on the single-crystal Cu spheres studied by Menzel (Abstr. 6144/1950) were etched with KCN and reduced by maintaining them at 300-600°C in 3-10 mm Hg hydrogen for 2-10 sec. The orientations of the reduced Cu were studied by electron diffraction and the results which are tabulated show that the types of orientation appearing in the oxide layers occur also in the reduced layers. S.Weintroub

548.55

2534. PREPARATION AND INSPECTION OF HIGH-PURITY COPPER SINGLE CRYSTALS. J.H.Wernick and H.M.Davis.
J. appl. Phys., Vol. 27, No. 2, 149-53 (Feb., 1956).

A simple and inexpensive vacuum procedure has been employed to grow copper single crystals by the Bridgman method. Crystals grown at a lowering rate of 2 inches per hour have a high degree of perfection as indicated by the presence of Kikuchi lines on electron diffraction patterns. The perfection varies along the length of the crystal, that portion freezing last being the most perfect. It is suggested that this variation in perfection along the length will occur to some degree in all unseeded crystals made by the Bridgman method because of the greater supercooling that occurs when the first metal freezes. A.

548.55 : 535.34

2535. DIRECT PRODUCTION OF SPECTROSCOPIC SPECIMENS FROM SINGLE CRYSTALS BY CONTROLLED GROWTH FROM A VAPOR. S.Zwerdling and R.S.Halford.
J. chem. Phys., Vol. 23, No. 12, 2215-20 (Dec., 1955).

Studies of anisotropic infrared absorption demand quite thin sections of single crystals, having relatively large cross-section parallel with one of the few spectroscopically significant planes. This article describes the principles of design, the construction, and the successful operation with benzene of an apparatus for producing such specimens of single crystals. The method involves gradual introduction of vapour into an enclosed space, supporting a gradient of temperature and having the shape desired for the specimen, until self nucleation occurs in a small vicinity of the colder pole of temperature. Processes of attrition among the nuclei ensue automatically and instantaneously, resulting in the survival of only those that become attached to the confining wall with a most favoured orientation, an orientation that can be selected to some degree by factors of design and operation. Thereafter, vapour issuing into the enclosure accretes upon the few surviving nuclei until these seeds coalesce and develop to fill the entire volume available. The method promises to be especially useful for producing and investigating crystals that exist only at low temperatures. A.

548.55 : 537.311.33

2536. GROWTH AND SOME PROPERTIES OF A LARGE SINGLE CRYSTAL OF CADMIUM SELENIDE. D.M.Heinz and E.Banks.
J. chem. Phys., Vol. 24, No. 2, 391-8 (Feb., 1956).

Large single crystals of cadmium selenide have been grown under high pressures. A 17 gram crystal has been prepared from pure starting materials. This crystal was found to contain a large excess of cadmium, probably varying in concentration through the length of the crystal. Samples cut from the crystal had low resistivities of about 10^{-2} ohm. centimetre. Hall coefficients indicated that the current carriers were electrons in concentrations of 10^{17} to 10^{18} cm^{-3}.

The resistivity-temperature curves were characteristic of degenerate semiconductors. Intrinsic conductivity was not observed between -170°C and $+100^{\circ}$C. A.

548.574

2537. ON THE MODES OF ACTION OF CHEMICAL ETCHES ON GERMANIUM MONOCRYSTALS. G.Della Pergola and D.Sette.
Alta Frequenza, Vol. 24, No. 6, 499-519 (Dec., 1955). In Italian.

30 photomicrographs show the surface structures obtained by successively increasing exposures of particular faces to standard etches as follows: superoxol etch on (100) and (111) faces; CP4 etch on (100) and (111) faces; WAg etch on (100) and (111) faces; copper nitrate etch on (100) and (111) faces. All the etches contain HF and their compositions are tabulated. Resistivity measurements obtained with a 4-probe jig show improved consistency on etching with superoxol after mechanical lapping, whereas CP4 gives irregular results generally in excess of the true value. F.F.Roberts

548.574 : 539.373

FORMATION OF ETCH PITS ON SLIP LINES IN ALUMINIUM. See Abstr. 1657.

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

2538. DYNAMICAL THEORY OF CRYSTAL LATTICES. M.Born and K.Huang.
Oxford: Clarendon Press (1954) xii + 420 pp.
Review in Proc. Phys. Soc. A, Vol. 68, Pt 11, 1092-3 (Nov., 1955).

548.7

2539. A METHOD OF CALCULATING THE SPECTRAL DENSITY OF THE PROPER FREQUENCIES OF VIBRATION OF A CRYSTAL ARRAY. J.Peretti.
C.R. Acad. Sci. (Paris), Vol. 241, No. 5, 461-3 (Aug. 1. 1955). In French.

A brief outline of a method based on the Hamilton equations and the Born—von Kàrman conditions. The properties of the characteristic function derived are summarized. The resolution of the integral equation is discussed elsewhere (Abstr. 790/1956). A.J.Kennedy

548.7

2540. THERMAL VIBRATIONS OF ATOMS IN CUBIC CRYSTALS. I. THE TEMPERATURE VARIATION OF THERMAL DIFFUSE SCATTERING OF X-RAYS BY LEAD SINGLE CRYSTALS. L.Cartz.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 951-6 (Nov., 1955).

The intensity of thermal diffuse scattering of X-rays which normally increases with rise of temperature is expected to decrease with temperature increase for scattering near to high-order reciprocal lattice points for crystals of low Debye characteristic temperature. Observations on lead single crystals agree well with theory. This decrease of diffuse scattering occurs when short thermal wavelengths are becoming predominant in the lattice, and so should be related to the melting point. A relationship between the Debye characteristic temperature and the melting point is obtained which has also been derived by Lindemann from other considerations. A.

548.7

2541. THERMAL VIBRATIONS OF ATOMS IN CUBIC CRYSTALS. II. THE AMPLITUDE OF ATOMIC VIBRATIONS. L.Cartz.
Proc. Phys. Soc. B, Vol. 68, Pt 11, 957-67 (Nov., 1955).

The Lindemann relationship between the Debye characteristic temperature and the melting point may also be obtained from a consideration of the temperature variation of thermal diffuse X-ray scattering. The amplitude of thermal vibrations of the atoms in cubic crystals can be expressed in terms of the distance between neighbouring atomic positions and the melting point. This leads to a correlation of the relative increases of disorder on melting of body-centred cubic and face centred cubic crystals with the thermal behaviour of the elastic constants, electrical resistance, atomic diffusion, specific heat, thermal expansion and thermal conductivity. A "law of corresponding states" may be said to exist where, at corresponding temperatures, the amplitudes of atomic vibration are the same fraction of the distance between neighbouring atomic positions in the solid. The Debye temperature factor is found to be inversely proportional to the melting point for cubic structures. A.

548.7

2542. ON THE OPTICAL PROPERTIES OF SOLIDS. H.B.Rosenstock.
J. chem. Phys., Vol. 23, No. 12, 2415-21 (Dec., 1955).

A consistent treatment of the usual linear theory of lattice vibrations in ionic crystals without the use of the simplifying cyclic boundary conditions is shown to lead to an electric moment associated with each normal frequency which, like the frequency itself, is a quasicontinuous function of the propagation vector. As a result, a broadening of the line spectrum of elementary theory and additional absorption edges of apparently observable magnitude are predicted. A.

548.7

2543. TAMM CONNECTED STATES OF ELECTRONS ON THE SURFACE OF A CRYSTAL AND THE SURFACE OSCILLATIONS OF THE ATOMS OF A LATTICE. I.M.Lifshits and S.I.Pekar.
Uspekhi fiz. Nauk, Vol. 56, No. 4, 531-68 (1955). In Russian.

The first two sections of the paper are by Pekar and the last section by Lifshits. The first section gives a survey of the stages of development of the Tamm surface states of electrons. The second is given to an examination of phenomena in which surface states of electrons play a substantial part whilst the experimental evidence is brought together for the actual existence of these states in real crystals. The third section sets out the theory of the surface oscillations of a crystal lattice which is mathematically close to, and genetically associated with, the theory of the surface states of electrons. 68 refs. C.R.S.Manders

548.7

2544. SPECULATIONS ON THE ENERGY BAND STRUCTURE OF ZINC-BLENDE-TYPE CRYSTALS. F.Herman.
J. Electronics, Vol. 1, No. 2, 103-14 (Sept., 1955).

A semi-empirical perturbation scheme is developed for the purpose of relating the energy band structures of diamond-type and zinc-blende-type crystals. The objective is to predict the approximate location of the valence and conduction band edges in the reduced zone for some of the better known zinc-blende-type crystals. A brief discussion of the effect of the spin-orbit interaction upon the band structure of zinc-blende-type crystals is also included. A.

548.7

2545. SURFACE DISTRIBUTIONS OF DISLOCATIONS IN METALS. C.J.Ball and P.B.Hirsch.
Phil. Mag., Vol. 46, 1343-52 (Dec., 1955).

It is shown that a boundary containing dislocations of two systems can, in general, form on two, and only two, planes, which have simple indices, and that the rotation axes are simple crystallographic directions. Most of the experimental evidence on misorientations in deformed crystals can be explained in terms of such simple boundaries. A.

548.7

2546. THE SCATTERING OF LOW-FREQUENCY LATTICE WAVES BY STATIC IMPERFECTIONS. P.G.Klemens.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1113-28 (Dec., 1955).

The scattering of lattice waves by static imperfections is treated by second-order perturbation theory. The transition matrix is composed of contributions due to the mass difference of lattice points, changes in the elastic constants of linkages between lattice points, and elastic strain. Point imperfections are shown to scatter as the fourth power of frequency, dislocations as the first power, and grain boundaries independently of frequency. The magnitude of the scattering cross-section is estimated for a variety of lattice defects in alkali halides, for screw and edge dislocations and for grain boundaries. These results are discussed in relation to thermal conduction by the lattice at low temperatures. A.

548.7

2547. MODIFICATION OF THE PEIERLS–NABARRO MODEL FOR EDGE DISLOCATION CORE. H.B.Huntington.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1043-8 (Dec., 1955).

The various assumptions implicit in the Peierls–Nabarro treatment of the core of an edge dislocation are critically reviewed. It is pointed out that the lattice barrier for dislocation motion, for the case where atom rows alternate along the slip plane, has twice the period and a much higher amplitude than for the case usually considered, where the atoms face each other across the slip plane. The resolution of this and other difficulties can be accomplished by arranging that the stress across the slip plane and its associated interaction potential be functions of the final, rather than the initial, position of each atom row. With this modification the lattice barrier has in every case the periodicity of the slip distance but the argument of the exponential factor controlling the height of the barrier is halved. The physical implication of this last result must await a more detailed treatment of the dislocation core than has been previously attempted. A.

548.7 : 539.4.016.2

2548. DISLOCATION DENSITIES IN SOME ANNEALED AND COLD-WORKED METALS FROM MEASUREMENTS ON THE X-RAY DEBYE–SCHERRER SPECTRUM. G.K.Williamson and R.E.Smallman.
Phil. Mag. (Ser. 8), Vol. 1, 34-46 (Jan., 1956).

Two basic equations are derived for deducing the dislocation density in powdered materials from the particle size and strain breadth measured from the Debye–Scherrer spectrum. In the particle size estimate, it is assumed that the material has a block structure similar to that found in microbeam studies and that the dislocations lie along the block surfaces. The number of dislocations along each face, n, is not known. In the strain broadening estimate the X-ray line broadening from a dislocation array is calculated in terms of the broadening due to an isolated dislocation and a strain energy factor F, which allows for the effect of dislocation arrangement. Both methods involve an unknown quantity but by equating the two results it is possible in most cases to get both a narrow bracket for the dislocation density and considerable information on the dislocation arrangement. In annealed metals the values of ρ range from 2×10^7 cm of dislocation line per cm^3 for aluminium to 3×10^8 for tungsten and molybdenum, the majority of dislocations being 'random', i.e. the number along each edge is approximately 1. There is some correlation between ρ and the purity and annealing treatment of the powder. High purity and high annealing temperatures result in small dislocation densities. In cold-worked metals the dislocation density is more variable. A precise analysis is possible for aluminium; high purity aluminium filed at room temperature gives $\rho = 4.5$ to 7.6×10^9 with evidence for recovery, possibly by polygonization. Commercially pure aluminium filed at both room temperature and liquid air give $\rho = 5 \times 10^9$ to 2.7×10^{10} and $\rho = 1.5 \times 10^{10}$ to 3.2×10^{11} respectively. Some dislocation array such as a 'pile-up', which causes an increase in the strain energy of dislocations exists in both these samples as with all the other metals examined. Dislocation densities are also given for tungsten, molybdenum, iron and α-brass. In α-brass, the only alloy considered, ρ is higher than for the pure metals and there is strong evidence that the dislocations are effectively random and that each dislocation is attached to a stacking fault. A.

548.7

2549. OBSERVATION OF DISLOCATIONS IN SILVER HALIDES. I. ANNEALED CRYSTALS. H.Kanzaki.
J. Phys. Soc. Japan, Vol. 11, No. 2, 120-6 (Feb., 1956).

It has been concluded that the distribution of both printed-out silver particles and chemical etching pits reveals that of dislocations in annealed crystals of silver chloride. In the crystals with (110) surfaces, however, the existing dislocations do not contribute to the formation of silver particles and in those with (100) surfaces the existing dislocations do not produce etch pits. The necessary condition for the formation of silver has been concluded to be the existence of extra effective charge on the surface of the crystal. A.

548.7

2550. OBSERVATION OF DISLOCATIONS IN SILVER HALIDES. II. STRAINED CRYSTALS. H.Kanzaki.
J. Phys. Soc. Japan, Vol. 11, No. 2, 126-9 (Feb., 1956).

The appearance of sub-boundaries are revealed in the crystals of AgCl and AgBr deformed at room temperature, by the technique of printing-out and etching. The origin of sub-boundaries can be explained by the progress of polygonization during the deformation. A.

548.7 : 539.11

THE DISPLACEMENT OF ATOMS IN SOLIDS BY RADIATION. See Abstr. 1417.

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73 : 539.26

SCATTERING BY A SYMMETRIC POTENTIAL. See Abstr. 1649.

548.733

2551. INSTRUMENTAL FACTORS IN X-RAY DIFFRACTOMETER. P.Rautala and L.Hyvärinen.
Ann. Acad. Sci. Fennicae AI, No. 192, 14 pp. (1955).

A theoretical consideration of the various factors involved and of their elimination by the use of Fourier transforms: see Abstr. 4039 (1948), 4574 (1954). A.R.Stokes

548.733

2552. A VACUUM THERMOSTAT FOR X-RAY FINE-STRUCTURE (DIFFRACTION) CAMERAS. H.Weyerer.
Z. angew. Phys., Vol. 7, No. 11, 536-9 (1955). In German.

The thermostat was designed for precise measurements of lattice constants, and consists of a box inside which various X-ray cameras can be placed. The temperature can be controlled within limits of about ±0.02 deg C. A.R.Stokes

548.733

2553. JIG FOR ALIGNING SPECIMENS ON POLE FIGURE GONIOMETERS. J.Singer.
Rev. sci. Instrum., Vol. 26, No. 10, 963-4 (Oct., 1955).

An aligning jig for use with Schulz-type metal orientation goniometers is described. A procedure is given for calibrating the locating surface of the jig and using it to permit interchangeability between the Schulz head and the standard spectrometer specimen mount. The jig can be moved out of the way after aligning a sample without disturbing the sample. A.

548.733

2554. AN OPTICALLY FOCUSING X-RAY DIFFRACTION CAMERA. A.Franks.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1054-64 (Dec., 1955).

An optically focusing X-ray diffraction camera is used to obtain low-angle diffraction photographs. Focusing is accomplished by total external reflection either by one elastically bent optical flat to form a line focus, or by two crossed flats to form a point focus. The beam is partially monochromatized and its intensity is high. Spacings greater than 600 A have been resolved. A.

548.733

2555. A MICROBEAM BACK-REFLEXION X-RAY CAMERA. D.Lewis.
J. sci. Instrum., Vol. 32, No. 12, 467-8 (Dec., 1955).

A direct and accurate optical method of specimen location has been developed to be used with a microbeam back-reflection X-ray camera. The beams were produced with a fine-focus tube and small pin-holes in platinum foil. Short exposure times were required for Laue and Debye–Scherrer photographs. A.

548.733

2556. THE TEMPERATURE CALIBRATION OF A HIGH TEMPERATURE X-RAY DIFFRACTION CAMERA. J.A.Brand and H.J.Goldschmidt.
J. sci. Instrum., Vol. 33, No. 2, 41-5 (Feb., 1956).

The accurate measurement, by a thermocouple, of the temperature of fibre specimens in an X-ray high-temperature camera of the type containing a spherical furnace enclosure, is investigated. Factors affecting the calibration of the thermocouple are discussed, and it is shown experimentally that the chief cause of discrepancies is the abstraction of heat along the thermocouple wires. Methods of calibrating the thermocouple in position, and for reducing the correction required to a minimum, are presented. A.

548.733

2557. SMALL ANGLE X-RAY DIFFRACTION UNIT. C.R.Worthington.
J. sci. Instrum., Vol. 33, No. 2, 66-9 (Feb., 1956).

A small angle X-ray diffraction unit consisting of a rotating anode X-ray tube and an evacuated X-ray camera is described. The X-ray camera can resolve a spacing of 1000 A with a separation of 2 lines per mm at the X-ray film. Photographs of the first twelve orders of moist collagen have been obtained, fully resolved, with exposures of less than one hour. A.

548.735.4

2558. GRAPHICAL CALCULATION OF THE DETERMINANTS OF J.KARLE AND H.HAUPTMAN. G.von Eller.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 149-50 (Jan. 4, 1956). In French.

See Abstr. 10088 (1955). It is pointed out that the properties of spherical triangles can be used in the calculation of these determinants, and that these spherical triangles can be represented graphically on a Wulff net. A.R.Stokes

548.736.3

2559. ON THE STRUCTURE OF THIN SHEETS OF SALT CONDENSED AT LOW TEMPERATURES. I. ALKALI HALIDES. W.Rühl.
Z. Phys., Vol. 143, No. 5, 591-604 (1956). In German.

The Debye diagrams from thin sheets of alkali halides after different condensing temperatures and tempering treatments show that immediately after condensation the lines are broadened by between 0.4 and 0.7° in Bragg angle. From the breadth it can be deduced that the minimum size of the particles is 100 A to 200 A. All the alkali halides grow in the room temperature phase at 20°K, but LiI grows in a new hexagonal form ($a = 4.48$ A, $c/a = 1.62$), which transforms into the stable NaCl lattice very slowly at room temperature. W.M.Lomer

548.736.3

2560. ON THE STRUCTURE OF THIN SHEETS OF SALTS CONDENSED AT LOW TEMPERATURES. II. THE HALIDES OF THE HEAVY METALS Cu, Ag AND Tl. W.Rühl
Z. Phys., Vol. 143, No. 5, 605-22 (1956). In German.

Debye patterns of CuI, AgI, TlCl, TlBr and TlI condense at 20°K show strong line broadening (2-4° halfwidth). The Tl halides gave patterns not attributable to any known structure. CuI and AgI recrystallize gradually as the temperature is raised; the Tl halides suddenly at a specific temperature. The crystallizability from the vapour and the ease of recrystallization may be related to the polarization of the molecules Strong polarization leads to quasi-amorphous structures. W.M.Lomer

548.736.4

2561. X-RAY STUDY OF PHASE TRANSITION OF FERROELECTRIC $PbTiO_3$ AT LOW TEMPERATURE. J.Kobayashi and R.Ueda.
Phys. Rev., Vol. 99, No. 6, 1900-1 (Sept. 15, 1955).

Evidence of a phase change at about −100° C is given by the appearance of superlattice lines on powder photographs, and by discontinuous changes of lattice parameters, at this temperature. The c-axis has a negative temperature coefficient below the transition temperature. A.R.Stokes

548.736.4

2562. THE WATER MOLECULE IN THE CRYSTAL OF LITHIUM HYDROXIDE MONOHYDRATE. H.Rabaud.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1959-61 (Dec. 19, 1955). In French.

The structure is described, and the configuration of the water molecule is discussed. A.R.Stokes

548.74 : 538.221

2563. NEUTRON DIFFRACTION STUDY OF THE MAGNETIC PROPERTIES OF THE SERIES OF PEROVSKITE-TYPE COMPOUNDS $[(1-x)La, xCa]MnO_3$.
E.O.Wollan and W.C.Koehler.
Phys. Rev., Vol. 100, No. 2, 545-63 (Oct. 15, 1955).

The investigations have been made primarily by neutron diffraction methods, but X-ray diffraction measurements of lattice distortions and ferromagnetic saturation data are also included. This series of compounds exhibits ferromagnetic and antiferromagnetic properties which depend upon the relative trivalent and tetravalent manganese ion content. The samples are purely ferromagnetic over a relatively narrow range of composition (x about 0.35) and show simultaneous occurrence of ferromagnetic and antiferromagnetic phases in the ranges $(0<x<0.25)$ and $(0.40<x<0.5)$. Several types of antiferromagnetic structures at $x = 0$ and $x>0.5$ have also been determined. The growth and mixing of the various phases have been followed over the whole composition range, the ferromagnetic and antiferromagnetic moment contributions to the coherent reflections have been determined, and Curie and Néel temperatures have been measured. The results have been organized into a scheme of structures and structure transitions which is in remarkable accord with Goodenough's predictions based on a theory of semicovalent exchange. A.

548.74 : 541.6

2564. THEORY OF THE ROLE OF COVALENCE IN THE PEROVSKITE-TYPE MANGANITES $[La, M(II)]MnO_3$.
J.B.Goodenough.
Phys. Rev., Vol. 100, No. 2, 564-73 (Oct. 15, 1955).

The theory of semicovalent exchange is reviewed and applied to these manganites. With the hypothesis of covalent and semicovalent bonding between the oxygen and manganese ions plus the mechanism of double exchange, detailed qualitative predictions are made about the magnetic lattice, the

crystallographic lattice, the electrical resistivity, and the Curie temperature as functions of the fraction of Mn^{4+} present. These predictions are found to be in accord with findings from neutron-diffraction and X-ray data (see preceding abstract) as well as with the earlier experiments on this system by Jonker and van Santen. A.

548.74 : 548.5

2565. THE AUTOMATIC RECORDING OF ELECTRON DIFFRACTION PATTERNS APPLIED TO THE STUDY OF EVAPORATED COPPER LAYERS. R.B.Kehoe, R.C.Newman and D.W.Pashley.
Brit. J. appl. Phys., Vol. 7, No. 1, 29-31 (Jan., 1956).

An apparatus has been constructed which successively records complete electron diffraction patterns after preset time intervals. This has been used in conjunction with a reflection specimen furnace of new design in the study of the growth of copper evaporated on to flat (111) silver surfaces. A.

GEOPHYSICS 55

550.380.87

2566. METHOD FOR ELIMINATING SLOW VARIATIONS IN THE RECORDING OF PULSATIONS OF THE TERRESTRIAL MAGNETIC FIELD. P.A.Blum and A.Lebeau.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1807-9 (Dec. 14, 1955). In French.

Registration of rapid variations of the earth's magnetic field of the order of several minutes to 1 sec. requires a variometer of high dynamic sensitivity. It requires also zero static sensitivity in order that it may not be hindered by slow variations, especially diurnal. A magnetic variometer is used with a compensator to produce zero static sensitivity by compensation of a selected component of the earth's field. Two methods are outlined (1) a compensating field produced by the compensating current of the Dürschner type of electronic variometer, (2) a magnetic variometer or magnetic balance. R.S.Read

550.93

2567. ON GEOLOGIC AGE DETERMINATION BY THE POTASSIUM–ARGON METHOD. W.Gentner and W.Kley.
Z. Naturforsch., Vol. 10a, No. 11, 832-3 (1955). In German.

Recent experimental data on the decay constants of potassium into argon and calcium make the method more satisfactory. The present paper describes two alternate methods of extracting the argon and shows that they yield substantially the same values. J.M.Hough

550.93 : 539.16.08

2568. YALE NATURAL RADIOCARBON MEASUREMENTS. II. R.S.Preston, E.Person and E.S.Deevey.
Science, Vol. 122, 954-60 (Nov. 18, 1955).

For Pt I, see Abstr. 902 (1954). Technique has been modified to use the acetylene instead of the solid carbon method of counting. Dates for about 70 samples classified as Alaskan Little Ice Age, North American Geology, Caribbean Archeology and miscellaneous are given. J.M.Hough

ATMOSPHERE. METEOROLOGY 551.5

551.510.42

2569. INTERPLANETARY DUST AND PHYSICAL PROCESSES IN THE EARTH'S UPPER ATMOSPHERE. T.R.Kaiser and M.J.Seaton.
Mem. Soc. Roy. Sci. Liège, Vol. 15, Special No., 48-54 (1955).

Solid particles in stars colloquium paper. See Abstr. 872 (1956). The density of interplanetary matter entering the earth's upper atmosphere is too low for the individual particles to play a major role in most problems of atmospheric physics; though they are probably important in ionospheric nocturnal E-ionization, and the thermal balance. D.R.Barber

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.510.535

2570. DISCUSSION ON THE IONOSPHERIC PROGRAMME DURING THE INTERNATIONAL GEOPHYSICAL YEAR.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 9-14. See Abstr. 823 (1956).

Various speakers took part. The more important points discussed included: world coverage; Canadian plans; "World Days"; calculation of ionospheric solar indices; radio noise observations. G.M.Brown

551.510.535

2571. THE E (LAYER) AND ASSOCIATED PROBLEMS IN LOW-PRESSURE PHYSICS.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 14-27. See Abstr. 823 (1956).

Large apparent changes of recombination coefficient (indicated by measurements of the difference between a.m. and p.m. values of fE) were stated by E.V.Appleton to be unlikely and probably to arise from some form of layer distortion. Some of the theoretical results derived by Appleton and A.J.Lyon (see also Abstr. 5765/1955) were described, and various anomalies with experimental data presented.
D.F.Martyn summarized theoretical results obtained for the distortion of a Chapman region due to a height gradient of recombination coefficient, and to the influence of vertical drift. The equations are particularly adaptable to the study of the distortions of the F2 layer due to vertical drift occasioned by the polarization field communicated from a lower dynamo region (in which the main currents responsible for the lunar variations flow). G.M.Brown

551.510.535

2572. VARIATIONS OF THE E-LAYER. D.H.Menzel and J.G.Wolbach.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 27-32. See Abstr. 823(1956).

Account of an analysis of world-wide values of monthly mean hourly fE data as a function of solar zenith angle, latitude, and phase of the sunspot cycle. The data used covered nearly one sunspot cycle (1945-53), and empirical equations are given relating the various parameters for the northern and southern hemispheres separately.

In the discussion, W.J.G.Beynon described some results obtained from an analysis of diurnal and seasonal variations of fE. G.M.Brown

551.510.535

2573. RECENT LABORATORY EXPERIMENTS OF INTEREST FOR THE PHYSICS OF THE IONOSPHERE.
H.S.W.Massey.

Proc. Mixed Commission of the Ionosphere, Brussels (1954) 32-40. See Abstr. 823 (1956).

Electron–ion recombination processes in afterglows have been studied by microwave methods and in general lead to rather high values of the recombination coefficients. They tend to confirm the dominant role of dissociative recombination. Some recent results are quoted for absorption cross-sections and ionization efficiencies (number of ions produced per photon absorbed) of atmospheric gases at different wavelengths, including that of Lyα. Microwave afterglow studies have been used to measure rates of radiative attachment, and a new technique of measuring the electron current from an irradiated beam of negative ions has given information on radiative detachment rates. In all cases the measurements agree with theoretical values. Ionic probe afterglow methods have also given values for the first time for the coefficient of two-body recombination between positive and negative ions.

G.M.Brown

551.510.535

2574. THE D-LAYER AND NITRIC OXIDE. M.Nicolet.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 40-3. See Abstr. 823 (1956).

Photoionization of NO (concentration approx. 10^8 mols/cm^3) by Lyα radiation is considered to be the source of the D region at 80 km and below. Between 90 and 100 km ionization of O_2 by coronal radiation is probably effective, while the E-layer is considered to be due to X-ray ionization. Fluctuations in NO concentration (e.g. due to atmospheric motions) probably account for variations in the ionization of the D-layer.

G.M.Brown

551.510.535

2575. GEOMAGNETIC DISTORTION IN REGION F2, ITS NATURE AND ORIGIN. M.Hasegawa.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 43-8; Appendix 49-57. See Abstr. 823 (1956).

Summary of recent Japanese work on the interpretation of F2-layer distortion in terms of vertical electron drift. Calculated diurnal variations of maximum electron density and height of the F2-layer at Huancayo based on geomagnetic data agree well with the same parameters obtained by Martyn from ionospheric data. Other possible causes of F2 anomalies are mentioned.

Appendix. Provisional report on geomagnetic distortion of the F2 region on the magnetic equator. M.Hirono and H.Maeda.

The velocity of vertical electron drift at a height of 300 km on the magnetic equator due to the variations of electrical conductivity of the "S_q-layer" has been calculated as a function of local time. The effects of this on an ionized region are briefly considered. The required electrical conductivity of the E-region seems to fit radio estimates for the magnetic equator. G.M.Brown

551.510.535

2576. IONOSPHERIC STORMS. R.P.Lejay.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 58-70. See Abstr. 823 (1956). In French.

It is pointed out that individual storms differ so markedly that precise generalizations cannot at present be made. The "positive phase" is considered and it is shown that conclusions for 66 ionospheric storms at Poitiers over the period July, 1948–Dec., 1951 depend on the seasons. Care is also needed in the analysis of the spatial distribution of storms over the earth because it seems that local effects make conditions for a given storm very different at different places. G.M.Brown

551.510.535

2577. THERMAL TIDES IN THE EARTH'S ATMOSPHERE. H.K.Sen and M.L.White.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 174-81; Discussion, 72-3. See Abstr. 823 (1956).

An analysis of forced oscillations in a rotating atmosphere composed of a perfect gas in hydrostatic equilibrium is attempted, to assess the relative importance of thermal and gravitational tides in the production of the solar semi-diurnal atmospheric pressure oscillation. Several atmospheric models are considered: for an isothermal atmosphere the thermal and gravitational effects are about equal, for all other models the thermal effect exceeds the gravitational effect by a factor of about 100, with amplifications ranging from 200 to 8000. It is suggested that eddy viscosity effects at the base of the atmosphere may account for the phase discrepancy of about 2½ hours between observation and theory for most atmospheric models.

In the discussion, J.Bartels concludes that the large amplifications of the semi-diurnal and 8-hourly atmospheric tides are due to thermal contributions, and that resonance magnification cannot be high. S.Chapman reserves judgment.

G.M.Brown

551.510.535

2578. THE FORMATION OF THE E-LAYER. D.R.Bates.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 82-7. See Abstr. 823 (1956).

Recent rocket measurements and quantal calculations indicate that the maximum rate of photoionization of atomic oxygen will take place at about 140 km and may be responsible for the E2-layer. It seems almost certain that ionization of molecular oxygen (photoionization and/or pre-ionization) makes a major contribution to the formation of the E-layer. Further measurements are necessary before a decision on the importance of X-rays can be made. G.M.Brown

551.510.535

2579. FACTS TO BE TAKEN INTO ACCOUNT IN THE INTERPRETATION OF IONOSPHERIC PROCESSES. L.Vegard.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 88-102. See Abstr. 823 (1956).

Theories of the author previously described are summarized. The upper atmosphere is likened to a terrestrial corona, the structure of which is maintained by photoelectric action of solar X-radiation. The properties of corpuscular "bundles" are considered, and also their effects in the ionosphere. The relative intensity of the H-lines in aurorae shows a marked latitude effect as predicted by theory, and an altitude effect which indicates that the penetrating power of the proton rays is smaller than that of the electrons. The role played by proton excitation in the auroral spectrum and its bearing on measurements of ionospheric temperatures are considered.

G.M.Brown

551.510.535

2580. A CONTINUOUS WAVE RADIO METHOD OF STUDYING THE VARIATION OF CRITICAL FREQUENCY OF THE E-REGION OF THE IONOSPHERE. B.R.Rao and B.C.N.Rao.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 103-7. See Abstr. 823 (1956).

A new type of fading observed at Waltair during morning hours on signal-strength records of medium waves from Madras (640 km) is interpreted as due to variations of the equivalent paths in the ionosphere of singly and doubly reflected waves as the critical frequency varies. The period of fading depends on the actual rate of critical frequency variation, and almost minute-to-minute variations of foE can be determined over say half an hour to an accuracy greater than 0.01 Mc/s, assuming there is no layer lifting in the ionosphere.

G.M.Brown

551.510.535

2581. SOME RESULTS FOR THE E- AND F1-LAYERS. K.Rawer.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 107-13. See Abstr. 823 (1956). In French.

Writing the diurnal variation of foE in the form fE =

$K \cos^n \chi$ (χ = solar zenith distance) the variation of the constants K and n with latitude and solar cycle is discussed. The constants also show a small lunar variation in phase with the moon. Some results are also given for fF1 and M3000F1, and mention is made of the F1.5-layer, and the behaviour of the E- and F1-layers during the eclipse of 25 Feb., 1952.
G.M.Brown

551.510.535

2582. A NOTE ON GEOMAGNETIC DISTORTION IN THE F2 LAYER. E.V.Appleton.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 113-15. See Abstr. 823 (1956).

The "trough" of abnormally low values of ionization density centred on the magnetic equator at noon tends to disappear a.m. and p.m. and is replaced by a "crest" of abnormally high values during the late evening period. This is attributed to a contraction of the vertical thickness of the layer, just as the noon minimum is attributed to an expansion. G.M.Brown

551.510.535

2583. NOTE ON SOME ANOMALIES IN REGION F2 AND ON SPORADIC E MOVEMENTS. S.K.Mitra.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 135-9. See Abstr. 823 (1956).

Values of the ratio of noon ionization density of the F2-layer at sunspot maximum to sunspot minimum are greater in winter than in summer (as expected from F1—F2 bifurcation considerations) for temperate latitude stations, but the reverse for low (geomagnetic) latitude stations. Rising and falling solar activities also yield different values of the ratio. The diurnal variation of hourly values of fE_s at four Japanese stations shows similarities, particularly in summer, with time shifts of maxima or minima. These can be used to estimate wind velocities in the E-region, giving values of 35-55 m/sec. G.M.Brown

551.510.535

2584. IONOSPHERIC MOVEMENTS.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 71-2. See Abstr. 823 (1956).

Discussion following paper by Mitra (preceding abstract). D.F.Martyn states that due to a change in the relaxation time of the F-region from sunspot minimum to maximum, drift effects should be more important at sunspot minimum. The large difference in the sunspot cycle influences in regions F1 and F2 is a problem. G.M.Brown

551.510.535

2585. THE MAGNETO-IONIC THEORY AND THE EFFECT OF LONGITUDE IN THE F2-LAYER. D.Lepéchinsky.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 139-47. See Abstr. 823 (1956). In French.

Considerations of the magneto-ionic theory show that the mechanism of ionospheric reflection is essentially one of partial reflection in which the proportion of energy reflected depends both on the gradient of refractive index (which in the presence of collisions between electrons and molecules or ions is never infinite) and on the value of the refractive index. Quasi-transverse and quasi-longitudinal types of propagation must be distinguished for certain values of magnetic dip. These matters are relevant to considerations of the longitude effect in the F2-layer and stratifications of the E-layer, including Es. G.M.Brown

551.510.535

2586. MORPHOLOGY OF IONOSPHERIC STORMS. T.Nagata, T.Obayashi and K.Sinno.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 147-58. See Abstr. 823 (1956).

Recent results on the morphology of F2-region storms are summarized with reference to the two different types of variations Dst and DS and the combined disturbance D = Dst + DS. These disturbances are determined for both foF2 and h'F2. Variations with latitude, season, and geomagnetic and solar activity are considered, and also the average mode of development of storms. It seems that the range and phase of DS(foF2) and DS(h'F2) indicate most clearly the characteristics of storms. G.M.Brown

551.510.535

2587. A NOTE ON IONOSPHERIC WIND MEASUREMENTS AT WALTAIR (INDIA). B.R.Rao, M.S.Rao and D.S.Murty.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 158-61. See Abstr. 823 (1956).

Fading patterns of pulse signals received at three stations forming a right-angled triangle (N-S and E-W spacings ~ 110 m) have been used to measure daytime "wind" velocities and directions in the E-region (using 2.5 Mc/s) and F-region (using 5.9 Mc/s). Results indicate velocities of 40-80 m/sec (E-region) and 80-120 m/sec (F-region). In winter the direction is predominantly towards the S.W. both for the E- and F-regions; in summer towards the E. (E-region) and the N.W. (F-region). G.M.Brown

551.510.535

2588. METEOR ECHOES AND UPPER ATMOSPHERIC WINDS. J.S.Greenhow.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 163-4. See Abstr. 823 (1956).

Brief report of results obtained at Manchester for wind speeds and directions at 80-100 km altitude from measurements of the phase shifts imparted to a coherent pulse transmission after scattering from columns of meteor ionization. Harmonic analysis shows that the wind is principally semi-diurnal with velocity varying seasonally in the range 12-35 m/sec. but there are also other periodic and irregular components. G.M.Brown

551.510.535

2589. MEASUREMENTS OF WINDS IN THE UPPER ATMOSPHERE BY MEANS OF DRIFTING METEOR TRAILS. L.G.H.Huxley.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 164-74. See Abstr. 823 (1956).

A method of measuring upper atmospheric winds from the progressive phase change in a radiowave scattered from a drifting meteor trail is described, with details of the records taken at Adelaide and the method of calculation of drift velocities and directions. The total wind for each hour is found to consist of (a) a constant prevailing wind N.S. or E.W., (b) a diurnal periodic component, and (c) a semi-diurnal component. G.M.Brown

551.510.535

2590. NEW STUDIES OF SPORADIC-E IONIZATION. K.Rawer.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 181-90. See Abstr. 823 (1956). In French.

The following points relating to the parameters fEs and fbEs are considered: variation with distance of the correlation between simultaneous measurements at two stations; variation with time of the correlation of measurements at one station; intensification of daytime Es at the magnetic equator; seasonal variation; small lunar influence; other parameters for the characterization of the Es layer; origin of Es echoes and the interpretation of ionograms. G.M.Brown

551.510.535

2591. SOME STUDIES ON THE Es REGION. DISTURBANCE VARIATIONS OF THE Es REGION AND THE CURRENT-SYSTEM FOR THE S_D FIELD. S.Matsushita.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 194-211. See Abstr. 823 (1956).

The Es variation associated with geomagnetic disturbances, S_D(Es), is studied statistically. Its amplitude is about 0.5 Mc/s

and the variation shows peculiarities near the magnetic equator. The S_D current system required by the dynamo theory is calculated theoretically, taking into consideration the anisotropic conductivity, and it is concluded that the S_D(Es) variation may be due to vertical drift effects associated with the S_D field. G.M.Brown

551.510.535

2592. DETERMINATION OF THE ELECTRON CONCENTRATION AND THE COLLISION FREQUENCY IN THE IONOSPHERIC LAYERS FROM POLARIZATION PATTERNS OF THE o AND x WAVES. M.N.Saha.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 211-19. See Abstr. 823 (1956).

Report of work of B.M.Banerjee, R.Roy and J.K.D.Verma at Calcutta. By using short-duration exploring pulses (6-30 μsec) and a raster-sweep time base (12 lines each corresponding to 50 km equivalent height) it has been possible to separate the reflected o- and x-waves completely from the scattered waves due to moving electron clouds. The polarization pattern of the echoes has been studied by a radio polarimeter and the theory is presented which shows how to derive values of electron density and collisional frequency from measurements of the angle of tilt and axis-ratio of the polarization ellipses. G.M.Brown

550.510.535 : 550.385 : 551.594.5

2593. METEOR IONIZATION, MAGNETIC STORMS, AND THE AURORA. M.Dubin.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 219-29. See Abstr. 823 (1956).

Consideration of many aspects of the theories of magnetic storms and aurorae. It is suggested that meteoritic material may be the predominant cause of both phenomena, and some supporting experimental evidence is advanced. Discussion of the paper is reported in loc. cit. p. 75-6, where some strong objections to the theory are noted. G.M.Brown

551.510.535

2594. ABSORPTION MEASUREMENTS DURING THE INTERNATIONAL GEOPHYSICAL YEAR. W.R.Piggott.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 233-6. See Abstr. 823 (1956).

Survey of the objectives and methods of absorption measurements during the I.G.Y. Records of f_{min} are valuable provided precautions are taken to standardize the gain changes between day and night conditions. Use of c.w. signals involves difficulties of interpretation. Measurement of the absorption of cosmic noise radiations is especially useful in determining large absorption, e.g. during severe S.I.Ds. The pulse technique is a fairly arduous task and is at present still subject to some uncertainties of interpretation. G.M.Brown

551.510.535

2595. NOTE ON THE CONTINUOUS OBSERVATION OF h' AND FC OF THE IONOSPHERE ON USING A "SWEEP FREQUENCY" TECHNIQUE. Y.Aono.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 236-7. See Abstr. 823 (1956).

The method avoids the scaling of a large number of individual h'f records and gives a more convenient method of investigating minute ionospheric variations. No details are given. G.M.Brown

550.510.535 : 550.38

2596. SOME COMMENTS ON THE GEOMAGNETIC EFFECT IN THE F2-LAYER. O.Burkard.
Proc. Mixed Commission on the Ionosphere, Brussels (1954) 115-22. See Abstr. 823 (1956). In German.

Earlier work using equinox noon values has shown a geomagnetic influence on the ionization in region F2. Consideration is here given to the geomagnetic influence evident in solstice midnight values. It is shown that at the solstices the form of the variation with geomagnetic latitude may be quite different. An example is also given of conditions in December in which the noon values of the ionization for stations above about 30°N seem to show little or no geomagnetic effect. In the light of the results given, proposals are made for the distribution of new ionospheric sounding stations during the I.G.Y. G.M.Brown

551.521.63 : 535.23.08

SIMPLE ULTRAVIOLET RADIOMETER. See Abstr. 1019.

551.594.14

2597. RADIOACTIVITY OF THE ATMOSPHERE. H.Garrigue.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1971-2 (Dec. 19, 1955). In French.

Radioactive rain, fog and snow have been detected at the Puy de Dôme with a maximum on Nov. 25, 1955 corresponding to an activity of 10 beta-emitters per cm^3 of atmosphere with a period of 35 days. J.M.Hough

BIOLOGY 57/59

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.171.1

2598. THE SPATIAL VECTORCARDIOGRAPH. J.Keller and J.Ekiel.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 2, No. 1, 47-50 (1954).

A double beam c.r. tube is used to produce a stereoscopic image of the heart-vector locus, using 3 electrodes on the chest. Amplifiers combine the voltages and give a rotation to one image to simulate binocular viewing, and a long-delay screen is used with cut-off device for viewing one cycle only. Advantages are claimed over ordinary electro-cardiography. F.T.Farmer

612.79 : 535.39

2599. SPECTRAL REFLECTANCE OF HUMAN SKIN IN THE REGION 235-700 mμ. J.A.Jacquez, H.F.Kuppenheim, J.M.Dimitroff, W.McKeehan and J.Huss.
J. appl. Physiol., Vol. 8, No. 2, 212-14 (Sept., 1955).

See Abstr. 6957 (1955). Spectral reflectance recordings made on a number of Caucasians, negroes, and Japanese revealed appreciable individual differences in reflectance only in the range 300-700 mμ; they are related to differences in skin blood content and in pigmentation. The usefulness of the spectrophotometric method for studying blood content in the skin was demonstrated. A faint broad absorption band at 280-290 mμ may be caused by the keratin and perhaps other proteins of the stratum corneum. A.